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THE ELECTRICAL WORLD

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The New Brush Dynamo.

One of the greatest improvements in dynamos shown at the International Electrical Exhibition has been made by Mr. Brush, and is illustrated by the sixty-five light dynamo, exhibited at work in one of the spaces occupied by the Brush Electric Company.

The improvement was effected by substituting for the cast-iron core of the armature of the well-known 40-light Brush machine, one of wrought iron, constructed so that Foucault currents are more nearly completely obviated, and better ventilation secured. No other changes have been made; yet a dynamo giving 40 arc-lights has been so converted to one giving 65 arc-lights under a small increase of speed of rotation of the armature.

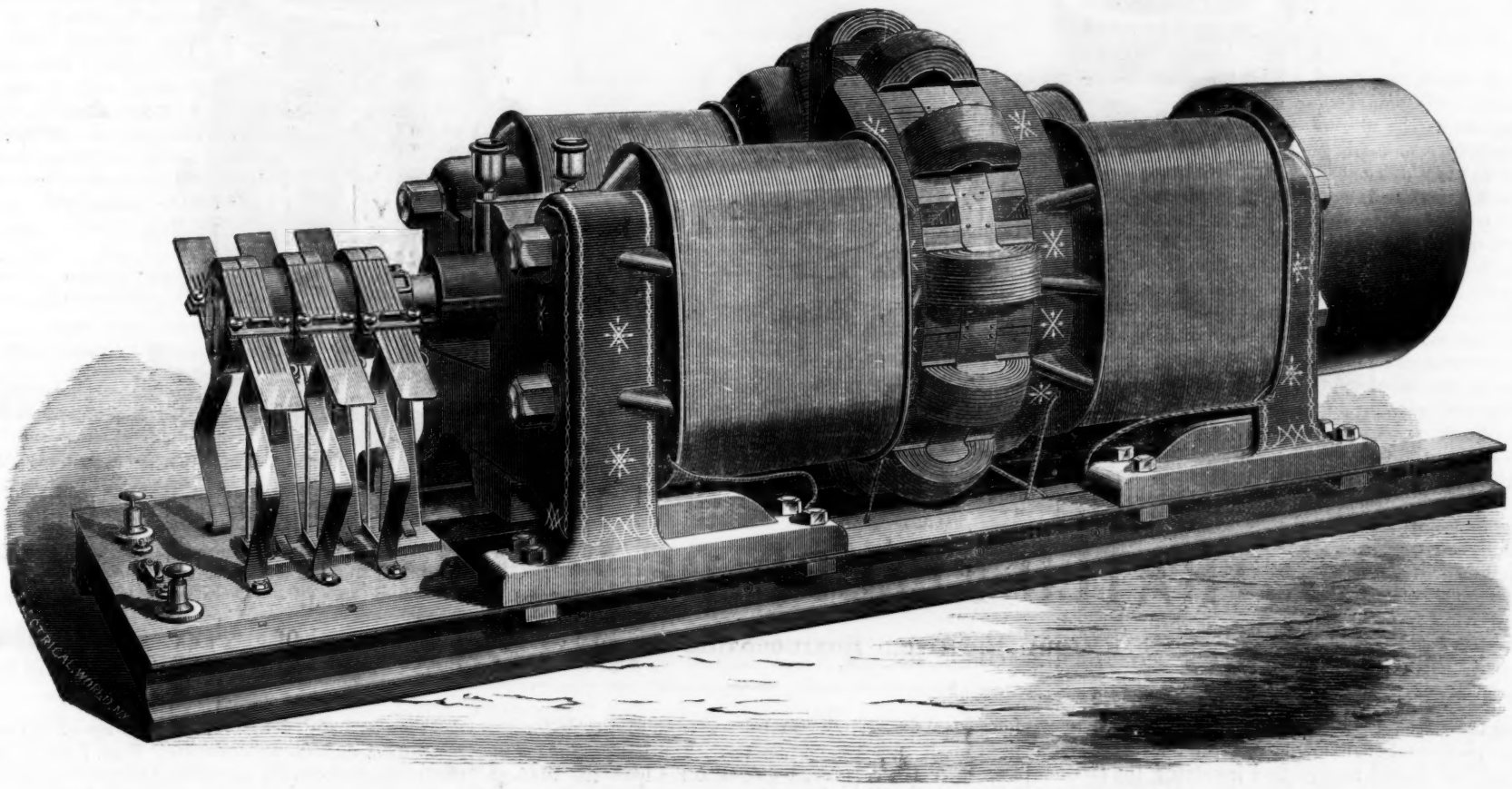


FIG. 1.—THE NEW BRUSH SIXTY-FIVE LIGHT MACHINE.

Fig. 1 shows this new dynamo and Fig. 2 the armature core partly wound with wire. A band of iron about $\frac{1}{16}$ of an inch thick and the width of the core within the bobbins, is wound circumferentially upon a ring in superimposed layers; but between the layers, as the winding proceeds, are placed pieces of sheet iron of like thickness, and having dimensions that give the form shown, when the band has been completely wound. There are about forty-five turns, or layers, to the band, and say forty-three layers of the pieces laid between them. These cross-pieces are separated by the thickness of the band, and the usual spaces are left to receive the bobbins.

Thus the iron is left quite open, with large heat-radiating surfaces, and with a structure more suited to the avoiding of Foucault currents than was the case with the former form of the armature core.

This new armature, wound in all respects like the older one, will give 50 arc-lights, each of the same size as each of the 40 arc-lights of the older machine, at the same number of rotations per minute—750. But, by reason of this improved construction, more energy may be applied to it without overheating. Consequently, the new armature is run at from 830 to 850 turns per minute, and produces at this speed ten ampères of current, having twenty-nine hundred volts difference of potential at the binding-posts of the machine.

The spider which supports the armature core has the extremities of its arms fastened to the lugs on the inner ring on which the band is wound, by bolts which pass through the holes in the lugs shown in Fig. 2.

While ten ampères of current suffice to supply the arc-lights on the circuit, it is sometimes desirable to have twenty ampères, as in the case of charging storage batteries during the daytime. Therefore Mr. Brush has devised a switch in the form of a hub on the armature shaft. By moving this hub one way, connections are made which place diametrically opposite bobbins in multiple-arc instead of series, so that the armature circuit has one-half the length it had before, and twice the cross-section. A switch on the base of the machine enables a corresponding change in the field-magnet bobbins. The machine is thus constituted to furnish a current of twenty ampères, and fourteen hundred and fifty volts.

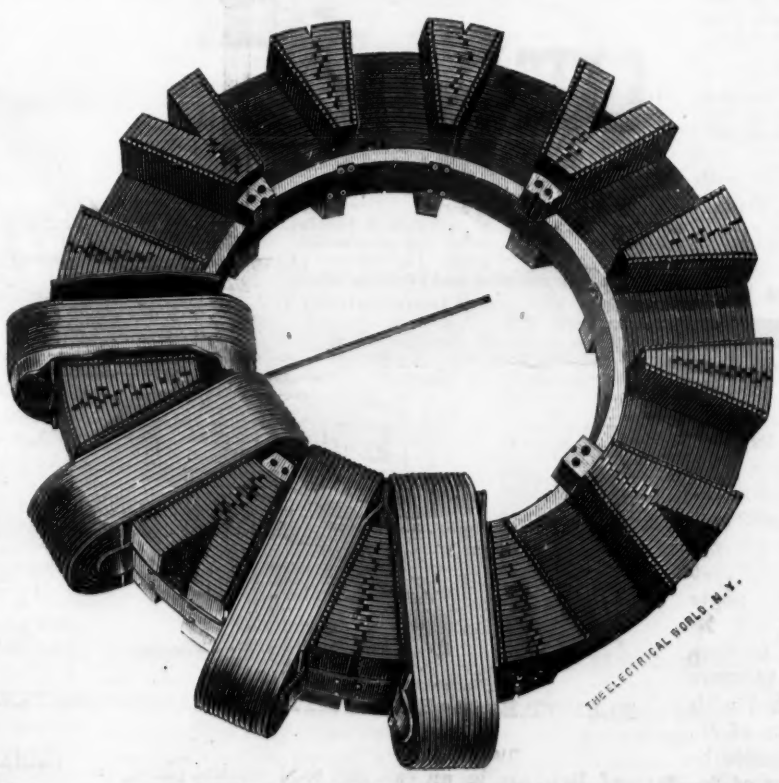


FIG. 2.—WINDING OF ARMATURE OF BRUSH DYNAMO.

The Brush dynamos are regulated to suit the varying requirements as to electromotive force, by an instrument called "The Dial." This consists of a varyable carbon-resistance, which connects the terminals of its field-magnet bobbins. An electro-magnet in the main circuit causes a lever to press together, more or less strongly, a lot of carbon blocks which constitute the variable resistance. If current rises the blocks are pressed more strongly together, thus decreasing the resistance of this shunt so that more flows in it and less around the field-magnet coils. There are four series-piles of carbon blocks. The changes by switches in the machine which bring about the increase of current to twenty ampères make the dial inoperative unless it be compensated. So a switch is provided on the dial to change the circuit though the carbon blocks to two series of two piles each.

It is not necessary to describe in detail the Brush machine, for our readers have no doubt often seen such descriptions of it. It suffices, for the present, at least, for us to call attention to the improvements made in it, in all its sizes. We will illustrate in an early future number other noticeable features of the Brush system of arc-lights, and incandescence lighting by the aid of storage or secondary batteries; and will illustrate the various novelties connected there with, such as are shown at the Electrical Exhibition.

Magnetometers at the Electrical Exhibition.

We have space in this issue to illustrate a few of the magnetometers shown at the Exhibition. These instruments are of great interest to the electrician, because they are used in the determination of the value of *H*, the horizontal component of the earth's magnetic force, at the place of making the determination. It is absolutely necessary to determine this value, because it furnishes the fundamental standard of measurement of all magnetic and electric quantities. The value of *H* varies with the locality on the earth's surface at which the value may be determined. Therefore it becomes necessary for any one who is to determine the value of any galvanometric needle deflection, by calculation from constants, to know the value of *H*.

Gray, in his work on "Absolute Measurements in Electricity and Magnetism," says: "The value of H may be determined in various ways, and I shall here content myself with describing the method which is most convenient in practice. It consists in finding (1) the angle through which the needle of a magnetometer is deflected by a magnet placed in a given position, at a given distance; (2) the period of vibration of the magnet when suspended horizontally in the earth's field, so as to be free to turn round a vertical axis. The first operation gives an equation involving the ration of the magnetic moment of the magnet to the horizontal component H of the terrestrial magnetic force, the second an equation involving the product of the same two quantities. I shall describe this method which was given by Gauss, somewhat in detail.

"A very convenient form of magnetometer is that devised by Mr. J. T. Bottomley, and made by hanging within a closed chamber, by a silk fibre from six to ten cms. long, one of the little mirrors with attached magnets used in Thomson's reflecting galvanometers. The fibre is carefully attached to the back of the mirror, so that the magnets hang horizontally, and the front of the mirror is vertical. The closed chamber for the fibre and mirror is very readily made by cutting a narrow groove to within a short distance of each end, along a piece of mahogany about ten cms. long. This groove is widened at one end to a circular space a little greater in diameter than the diameter of the mirror. The piece of wood is then fixed with that end down in a horizontal base-piece of wood furnished with three leveling screws. The groove is thus placed vertical; and the fibre carrying the mirror is suspended within it by passing the free end of the fibre through a small hole at the upper end of the groove, adjusting the length so the mirror hangs within the circular space at the bottom, and fixing the fibre at the top with wax. When this has been done the chamber is closed by covering the face of the wood with a strip of glass, which may be either kept in its place by cement, or by proper fastenings which hold it tightly against the wood. By making the distance between the back and front of the circular space small, and its diameter a very little greater than that of the mirror, the instrument can be made very nearly "dead beat," that is to say, the needle when deflected through any angle comes to rest at once, almost without oscillation about its position of equilibrium. A magnetometer can be thus constructed at a trifling cost, and it is much more accurate and convenient than the magnetometers furnished with long magnets frequently used for the determination of H; and as the poles of the needle may always in practice be taken at the centre of the mirror, the calculations of results may be much simplified.

"The instrument is set up with its glass front in the magnetic meridian, and leveled so that the mirror hangs freely inside its chamber. The foot of one of the leveling screws should rest in a small conical hollow cut in the table or platform, and another in a V-groove, the axis of which is in line with the hollow, and the third on the plane surface of the table or platform. When thus set up, the instrument is perfectly steady, and if disturbed can in an instant be replaced in exactly the same position. A beam of light passes through a slit, in which a thin vertical cross wire is fixed, from a lamp placed in front of the magnetometer, and is reflected, as in Thomson's reflecting galvanometer, from the mirror to a scale attached to the lamp-stand, and facing the mirror. The lamp and scale are moved nearer to or farther from the mirror, until the position at which the image of the cross-wire of the slit is most distinct is obtained. It is convenient to make the horizontal distance of the mirror from the scale for this position, if possible, one metre. The lamp-stand should also have three leveling screws, for which the arrangement of conical hollow, V-groove, and plane should be adopted. The scale should be straight, and placed with its length in the magnetic north and south line; and the lamp should be so placed that the incident and reflected rays of light are in an east and west vertical plane, and that the spot of light falls near the middle of the scale. To avoid errors due to variations in the length of the scale, it should be glued to the wooden backing which carries it, not simply fastened with drawing pins, as is often the case."

Then follows an account of the manner of making the deflecting magnet, the method pursued and the apparatus used in determining the period of oscillation of the deflecting magnet when suspended horizontally over the magnetic meridian, and the manner of presenting this magnet to the galvanometer needle in the first apparatus to cause a deflection. The whole reads like the recipe for "Stone soup" in which the other ingredients beside the stone made the soup.

However, such a magnetometer is correct in principle, but is too rough in construction to be absolutely reliable. We introduce the description because it will enable some one to make such an apparatus so as to study its principles and then hail with delight the acquisition of any one of the instruments which we illustrate. Figs. 1 and 2 represent two magnetometers of the famous Carpentier's Paris manufacture, exhibited by James W. Queen & Co. who have at the Exhibition such a profusion of electrical and other instruments of precision. The instrument in Fig. 1 is the Unifilar and that in Fig. 2 is the Bifilar. That is, the former has its needle suspended by a single silk thread, and the latter has its needle suspended by two such threads, placed parallel, a small distance apart. In both cases A is the needle in its cradle which is suspended by the thread, or fibre, of silk within the tube V from the point of suspension T. B is the case, $C C$, graduated scales used in reading the movement circumferentially of the parts on each other. M is a mirror hung below the needle, and movable therewith; and M^2 is a mirror fixed in the position shown. O is a circular disc of glass through which a beam of light is thrown upon and reflected back from the mirrors. These instruments necessitate the use of a lamp and gauge as in the Wheatstone reflecting galvanometer; and also the provision of a scale-rod on which to move or place the deflecting magnet.

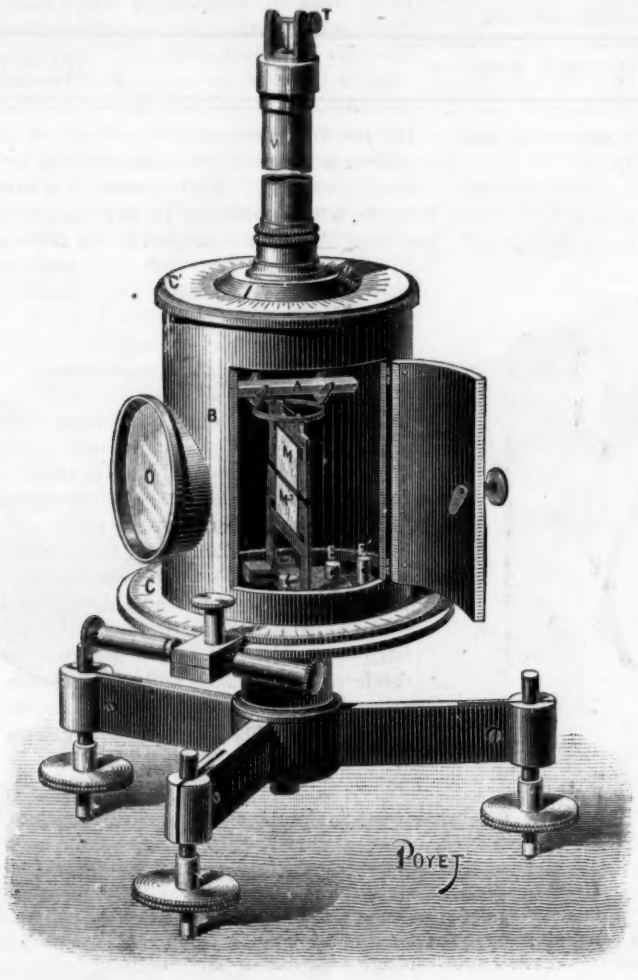


Fig. 1. CARPENTIER'S UNIFILAR MAGNETOMETER.

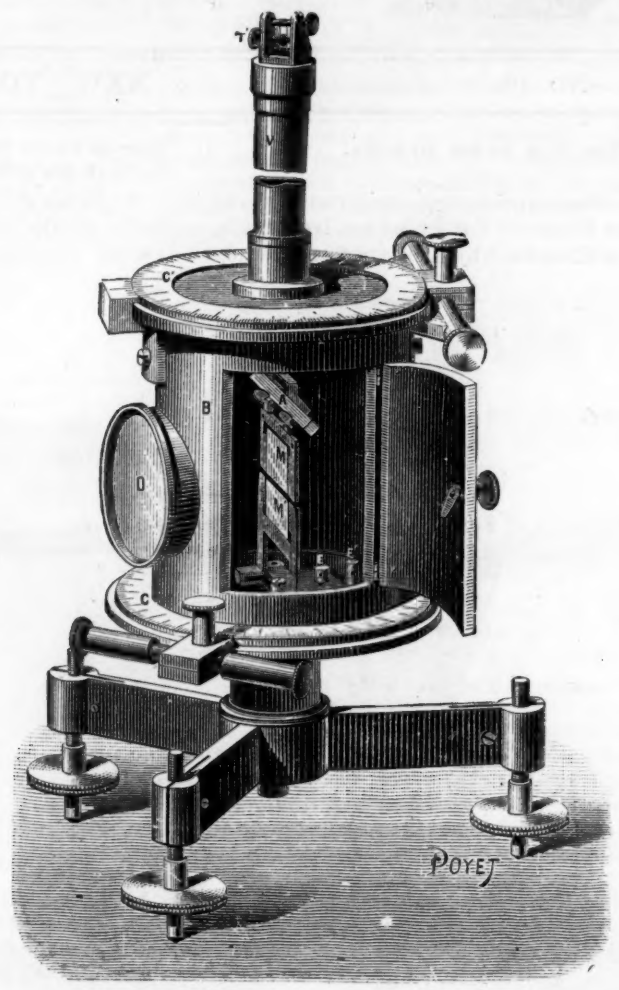


Fig. 2. CARPENTIER'S BIFILAR MAGNETOMETER.

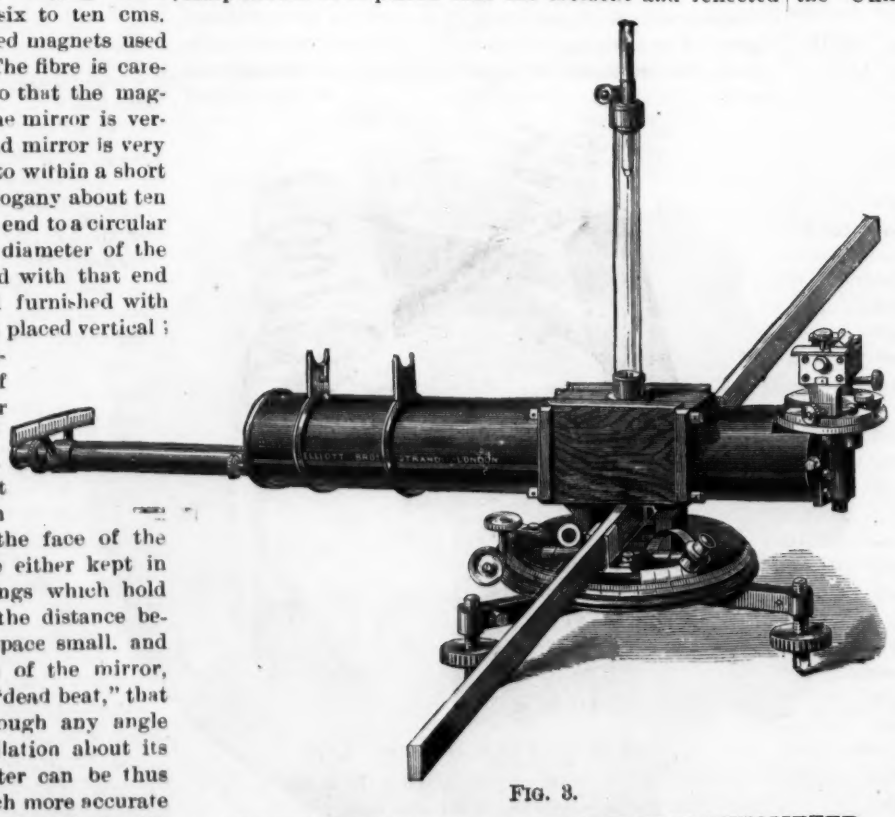


FIG. 3.

ELLIOTT BROS. KEW PATTERN MAGNETOMETER.

A much more complete instrument and far more costly is exhibited by the Electrical Supply Co., as made by the famous Elliott Bros., of London. It is illustrated by Fig. 3, as it appears when set up for determining deflection. The accessory apparatus for determining the period of oscillation of the deflecting magnet is included with the instrument. The cross rectangular bar has for it a cradle to carry the deflecting magnet. The readings are made through the telescope extending from the left side of the instrument in the figure. The scale over the telescope is reflected in the mirror attached to the needle carriage or stirrup within the box under the vertical glass tube which covers the silk suspension-fibre. A surveyor's tripod goes with the instrument for field or other work.

(TO BE CONTINUED).

U. S. NAVY CONTRACTS.—The contract for lighting the new steel cruiser Atlanta has been awarded to the United States Electric Lighting Company, of New York, and that for lighting the steel cruiser Boston to the Brush Electric Company, of Cleveland, Ohio.

Activity in Telegraphic Extension.

The dissolution of the tripartite telegraph pool has apparently stimulated the Baltimore & Ohio Company to extraordinary efforts in the extension of its lines. President Bates has been authorized to obtain estimates for extensions and improvements involving an expenditure not to exceed $2,000,000. That sum of money has been raised by the Baltimore & Ohio Telegraph Company and its friends. Plans and estimates are now being considered for extensions of the Baltimore & Ohio system to St. Paul, Minn., Kansas City, Richmond, Va., Norfolk, Va., Charleston, S. C., and Savannah, Atlanta and Augusta, Ga.

Interest on $3,000,000 of the bonds of the American Rapid Telegraph Company, amounting to about $100,000, fell due on the 15th and was defaulted. When the Rapid was merged into the Bankers & Merchants' a year ago, the obligations of the Rapid were assumed by the other Company. President Mott, of the Bankers & Merchants', said that the directors of his company had been conferring for some days with the holders of the Rapid bonds with a view of either getting an extension of time or funding the coupons in some way or other. Mr. Mott said that no definite plan had been suggested.

The new lines of the Baltimore & Ohio Telegraph Company to Boston, Providence, Newport, Hartford, and other New England points were opened for business on the 15th, and several messages were sent over them. The Baltimore & Ohio people are having a spirited struggle with Jay Gould down in Texas. After some trouble the Baltimore & Ohio company obtained authority from the courts to construct its lines along the Texas Pacific Railway from Texarkana to Sherman, a distance of 155 miles, upon payment to the company of $10 a mile. The money was deposited to the credit of the railroad company and the work of construction was begun. Mr. Gould's representatives, however, applied for an injunction, and the case will be argued this week.

The Western Union Quarterly Statement.

Subjoined is the statement issued by the Western Union Company on Sept. 10. The following statement will show the condition of the company at the close of the quarter ended June 30, 1884:

Surplus April 1, 1884, as per last quarterly report, $4,049,818; net revenues quarter ended June 30, 1884, $1,651,379. Total, $5,701,197.

From which deducting appropriations for dividend of 1¾ per cent. paid July 15, $1,399,807; interes on bonded debt, $123,920; sinking funds, $20,000; total, $1,543,728, leaves surplus, July 1, 1884, of $4,157,468.

The next revenues for the quarter ending Sept. 30 instant, based upon nearly completed returns for July, partial returns for August, and estimating the business for September, will be about $1,750,000.

Add surplus July 1, as above, $4,157,468. Total, $5,907,468. From which appropriating for interest on bonded debt $124,000, sinking funds $20,000; total, $144,000; less portion of the sinking fund for the bonds of 1900 (which was set aside previously) returned to the company by the sinking fund trustees because of the drawn bonds not having been presented for redemption, $40,000; total, $104,000, leaves a balance of $5 803,468. It requires for a dividend of ¾ per cent. on the capital stock, $1,399,810. Deducting which, leaves a surplus, after paying a dividend, of $4,403,658.

Explaining the Telephone to Edison.

A good story is going the rounds of the Exhibition with regard to the adventure of Mr. Edison with the attendant in charge of one of the "opposition" telephone exhibits. The latter gentleman has been most willing to explain the system to all who came to the exhibit, but he labored under the disadvantage of not knowing some of the most notable electricians by sight. Mr. Edison, looking not unlike a quiet, trim parson, went in his unpretentious way through the building, stopping here and there to look at objects of interest. It was natural that a telephone exhibit should arrest him, and as he stopped he was at once accosted courteously and offered information. For some minutes Mr. Edison listened gravely to a very clear and concise explanation of telephones in general and the merits of this system in particular. He made no sign as his interlocutor went on to expatiate eloquently on telephonic principles, the uses of the battery, the transmitter, the receiver, the magneto bell, the switch-board and other devices, but took it all in like the merest tyro who had never heard or seen a telephone before. When the explanation ended, Mr. Edison said simply: "Well, now, young fellow, you did that pretty well," and left. "Who's that?" asked the now suspicious victim of another exhibitor. "Oh! that's Mr. Edison." Tableau.

MILWAUKEE, WIS.—The total number of telephone subscribers at Milwaukee, Wis., is over 1,200, and the number of connections has risen to over 7,000 daily. The Wisconsin Telephone Co. has now in operation more than 1,200 miles of toll lines, and Milwaukee subscribers can talk with over 5,000 subscribers in fifty exchanges outside of Milwaukee, and with 2,500 people at 150 toll stations in the county, besides 1,200 subscribers in Milwaukee City, making a total of nearly 10,000 persons in the State, all of whom can be talked with direct from any subscriber's place of business in the city.

Diehl's Incandescence Lamp.

One of the novelties of the Electrical Exhibition is shown by Fig. 1. Mr. Philip Diehl, of Elizabethport, N. J., exhibits, in addition to other novelties which we will describe in subsequent issues, an incandescence lamp which has no conductive electric connection through the glass of the globe.

The currents which impart heat to the filament are induced alternating ones. In the stem of the globe there is

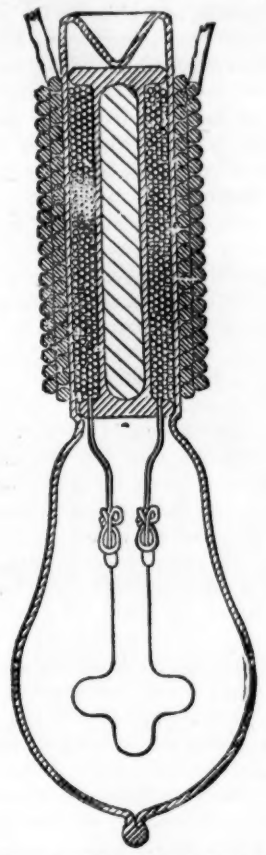


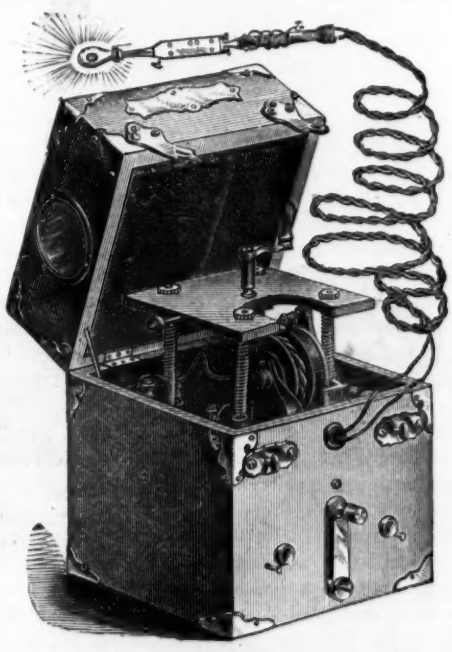
FIG. 1.—THE DIEHL LAMP.

placed a bobbin of wire the terminals of which are connected with the terminals of the filament. After exhaustion the globe is sealed as usual. The induced currents are produced by alternating currents from an alternating current machine. These currents are passed through the coarse-wire bobbin shown in the figure, and external to the stem of the globe.

In practice this primary coil, or bobbin, is mounted in an ornamental stand which serves as a support for the lamp when used as a drop-lamp. Mr. Diehl shows a considerable number of these lamps; and claims that the lights are economically produced as compared with the other systems of producing incandescence lights by alternating currents.

A Surgical and Dental Electric Lamp.

Not the least interesting, by any means, of the exhibits at the International Electrical Exhibition are those connected with the application of electricity in the healing arts. The inventions in this department are without the doubtful recommendation of huge bulk, and attract attention rather for their ingenuity than their appeal to those who are charmed by size, noise and dazzle.



THE ST. CLAIR SURGICAL LAMP.

In the space occupied by THE ELECTRICAL WORLD at the Electrical Exhibition may be seen some minute incandescence electric lamps, and the accessories therefor, made by R. M. St. Clair, M. D., of Brooklyn, N. Y. These articles are of great interest to the physician, surgeon and dentist, as well as to the public, who will be benefited by their use in diagnosticating the diseases flesh is heir to.

The doctor shows a convenient arrangement of four or six battery cells in a case which may be easily carried, and which has all conveniences for lowering and raising the electrodes into and out of the cells, making and breaking connections, and switching the desired number of cells into circuit, such as are needful in the use of the apparatus.

He also shows various convenient holders for small incandescence lamps, which are so mounted that they may be used by the dentist for illuminating the cavity of the mouth while examining the teeth. Some of them are inclosed in reflecting hoods so that the light may be directed upon one part of the mouth while the other parts remain in shade.

He has holders for platinum wire which is brought to incandescence by current from the battery, for use in cauterizing. Various other devices are shown for use in illuminating other cavities of the body, such as the aural, nasal, rectal and vaginal.

He has minute lamps for use as ornaments when the so presumably-ornamented person carries a small pocket battery about his person.

We illustrate by the engraving one of his battery cases with a lamp attached by means of a flexible conductor. Four cells in one of these cases give a current of seven volts. One of the small lamps has a resistance while cold of fifteen ohms

A Daft Electric Railway at Boston.

Considerable attention is being paid to the Daft electric railway fitted up at the Mechanics' Fair, Boston. The Boston *Herald* of Sept. 14 devotes nearly two columns to the subject. The generator and motor are the same in principle and general design as those used in THE ELECTRICAL WORLD exhibit at the Philadelphia Electrical Exhibition. The description says:

One of the chief novelties at the Mechanics' Fair is the electric railway, the first of its kind in New England. It is not a mere toy or model, but a curious little locomotive, and an equally curious car will carry visitors to and fro over the 400 feet of track during the continuance of the fair. The track is laid in the basement, the power operating the motor being derived from the large central steam engine there situated. In general features the road is very similar to the Daft road now in operation on the new iron pier at Coney Island. The rails are like those of the ordinary railroads, only smaller in section. No insulation of the track is attempted, since it is but little required, but to aid the conductivity at the joints the rails are united by thin strips of copper. The motor or locomotive is called the "Volta" and is a most peculiar looking machine not easily described. It has no cab, smokestack or headlight, but looks something like a heavy, dark green box, six feet long by three feet wide and three feet high, with a small "cowcatcher" in front and an open space for the manipulator's (or motoreer's) seat in the forward part. Back of and beneath this open space is the running gear or truck and the receiving dynamo, both boarded in from view, but accessible by means of side and end doors. In front of the driver's (or motoreer's) seat is a dashboard, to which are affixed a gong, the starting handle and the electric brake handle, which latter operates by leverage from electro-magnets which exert a tremendous bearing-down pressure upon the rear wheels. The lower half of the rear section contains the running gear, which consists of four 12-inch flange wheels, connected by means of countershaft and belt to the dynamo. In addition to the electric brake, there is a mechanical friction brake, worked by the driver's foot. By his right hand is the reversing lever. The whole affair is so simple that a boy could work it, even though he were totally ignorant of electric science. Two handles control the entire movement of the car—that of the electric brake and that of the starting switch which controls the circulation of the current in the receiving dynamo. As no great speed is possible in the exhibition building, the armatures of the receivers are not affixed to the axles, but a lower rate of speed is attained by using belting and a small pulley. The car is a handsome little open structure, made by the Whittier Machine Company, and so arranged that the passengers sit back to back, the car resembling in this respect those used by the Berlin electric railway.

WINONA MINN.—Mr. Wm. F. Phelps has been contributing some able letters to the local *Republican* in advocacy of the efficiency and economy of the electric light there. The Van Depoele system is in use.

LYNCHBURG, VA.—The Mobile, Ala., *Register* says: The city authorities of Lynchburg, Va., have entered into a contract with the Brooklyn Electric Light Construction Company to light the streets of Lynchburg with electricity for five years, at an estimated cost of $11,000 a year.

THE PREECE EXPERIMENTS AT WIMBLEDON.—We are in receipt of the following from Messrs. Woodhouse & Ranson, London: "We notice that you mentioned the Preece experiments at Wimbledon; you do not, however, mention that the very low price of one farthing (half a cent) per lamp per hour was obtained by the use of our new incandescent lamps. We have by this reduced the cost of electric lighting some 30 to 40 per cent. Mr. Preece also, when chairman of the Society of Arts, gave practically the same figures. We may mention that the accuracy of his statement has been proved by many tests of other authorities. His is more complete, as he has practically been able to test the life of the lamps very well, not one having broken during his experiments at Wimbledon, or during the six months that he has been lighting in his house." We have given lately some of Mr. Preece's own statements on the subject at Montreal.

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SCIENTIFIC THEORY AND PRACTICE.

One of the most notable passages in Macaulay's lively essay on Lord Bacon is that in which he praises the philosopher because the end proposed by him in his investigations was the multiplication of human enjoyments and the mitigation of human sufferings. The contrast is drawn sharply between the old philosophy and the new. The old could not condescend to the humble office of providing for the wants and necessities of poor humanity and all the schools looked upon such functions as low and degrading, even resenting any eulogy on science because perchance it had become practical in some way. But the new philosophy has, with not less noble impulses than the old, sought uses for its conquests in the domain of knowledge. "It has lengthened life; it has mitigated pain; it has extinguished diseases; it has increased the fertility of the soil; it has given new securities to the mariner; it has spanned great rivers with bridges of form unknown to our fathers; it has guided the thunderbolt inocuously from heaven to earth; it has lighted up the night with the splendor of the day; it has extended the range of the human vision; it has multiplied the power of the human muscles; it has accelerated motion; it has annihilated distance; it has facilitated intercourse, correspondence, all friendly offices, all dispatch of business; it has enabled man to descend to the depths of the sea; to soar into the air; to penetrate securely into the noxious recesses of the earth; to traverse the land on cars, which whirl along without horses, and the ocean in ships, which sail against the wind. These are but a part of its fruits, and of its first fruits." The passage is one that deserves to be repeated and remembered.

We have remembered and now repeat it, because it is called up by the fine address delivered by Prof. Rowland at the opening of the National Conference of Electricians last week, and printed in full in these pages. The address was worthy of the graceful compliment paid by Sir William Thomson in a speech of remarkable power and elevation, and it has our own humble appreciation of its many excellent points. But we regret that so large a portion of it was devoted to a consideration of, and remarks upon, the relative value of the work of the theoretical man of pure science and of the practical man of industrial application. This is evidently a theme that Prof. Rowland likes to hark back to on public occasions, yet we are fain to ask whether it is not a trifle outworn, and whether the line drawn between the two classes of men is not now a thin, or broken, or even imaginary one. It is true that here and there in the address Prof. Rowland admitted the "wholeness" of modern science, pure and applied, but the phrases and sentences were numerous which imply that the practical man is a sordid being and that a man who does not pursue pure science is not true to his highest nature. There is an implication, too, that the practical man can invent and devise nothing until the pure science man has kindly worked out a theory for him mathematically.

This being the tone and drift of Prof. Rowland's remarks—and we believe we are not wrong in interpretation—it is fitting to express our dissent from his opinions. It seems to us that the obligations between pure and applied science are mutual; and this fact was brought out with much skill by Sir William Thomson when praising Prof. Rowland's typical scientist—Archimedes. He said: "In his own mind, Archimedes perhaps scarcely recognized how much benefit his pure science derived from the necessity under which he felt himself to apply it to practical (patriotic) purposes." Besides, every practical scientist must have his theory before he goes to work; the idea of what is to be done must precede the doing; and our reading and observation convince us that the practical scientist has generally no need of a theoretical man to do his thinking for him. He does not cease to be a devotee of pure science when, seeing the chance of an application of his knowledge, he takes it but goes on investigating and seeking new truth as before. Sir William Siemens was not less passionately devoted to the interests of pure science because his every thought created something for the betterment of the conditions that surround us all and hold us down in a physical bondage. The gifted man who should have it in his power to render the lives of his fellows sweeter and brighter by new applications of science, but disclaimed doing so, would be, to use a homely figure, like a contemptuous gourmand who should pick his teeth in face of a hungry crowd.

We know of no holy orders in science. There is no distinction between clergy and laity in science. The only ground of selection for honor is that of achievement, and the scientist cannot set himself apart. So long as humanity suffers in the valleys and plains below, it is forbidden that those among men who have been granted visions of great truths shall keep themselves aloof and seek to build secluded observatories on their scientific Mount of Transfiguration.

Prof. Rowland did well to insist on the importance of mathematics, but he goes too far in saying that "no person at the present day has the right to express an opinion on any theoretical question connected with electricity without a knowledge of its mathematics." This savors of intolerance. Faraday would not have said it, and if it had been a law in his time, the science of electricity would not be so far advanced as it is to-day. Edison's mathematics would hardly qualify him for admission to a single college or university in the country, but we would rather have his opinion on electrical questions than that of most physicists or electricians. Prof. Rowland spoils a good recommendation by going beyond reasonable bounds with it. The same objection might be raised to his remark: "It is not telegraph operators but electrical engineers that the future demands." The idea is sound but it is harshly put. What we have to say about it will be found in another article on this page, written, however, before Prof. Rowland's remark was made.

Having offered a few criticisms, it only remains for us to advise our readers to study the address for themselves. It is that of a noble student of nature, one whose thoughts and researches entitle him to a hearing in any assembly, one whom we hope yet to welcome into the ranks of practical scientists as an exponent of the new philosophy as well as of the old.

TELEGRAPHERS AS SCIENTISTS.

It is a remarkable fact that of all the members of the United States Electrical Commission appointed by President Arthur, under a recent act of Congress, not one is, as far as we know, a practical telegrapher. It can be no disparagement of the illustrious members of that honorable Commission for us to express disappointment and regret that none of the immediate practical workers in telegraphy have been selected as members of that learned body. Napoleon III. and the notorious Marat, the hero of the first French revolution, killed by Charlotte Corday, were both close students of electricity, and both wrote readable essays on the subject. But their powers were not fully developed—they, like many other theoretical workers, needed association with, and sometimes instruction from, practical workers. Besides, no matter however erudite Professor So-and-So may be, the fact cannot be ignored that few of his kind have done much in the practical work of the past few years. Many, we might say most, of the inventors in this line, and all of those now directing the most practical applications of electricity, are graduates of the telegraph office. We do not desire to point out invidious comparisons to the disadvantage of the Professor So-and-So aforesaid, but only to qualify our regret already expressed that some practical telegraphers were not placed on the commission. First and foremost is Mr. Thomas A. Edison, a Ph. D., a Chevalier of the French Legion of Honor, the "Napoleon of Science," scarcely a dozen years from the operator's desk, yet admittedly far and beyond all the theoretical scientists in ability, fame and fortune. The famous Pope brothers, electricians of the first class, have all done good service in the telegraph office. Mr. P. B. Delany has done about as much and as hard telegraphing as any one, yet there is no practical or theoretical electrician whose opinion we would rather take. David Brooks, an electrician known throughout America and Europe, pounded his living out of a key for many years. Messrs. Stephen D. Field, Joseph Fenn, W. Maver, Jr., of the American fraternity, are all first-class electricians who would show singly or collectively that a university professor cannot give any odds to a practical operator when he wants to discuss electrical matters.

We have, therefore, to regret that one or more practical telegraphers were not put upon the Electrical Commission, to the end that we might have had a little more practical investigation and a trifle less theory. But, commission or no commission, the splendid abilities of our ex-operators shine forth equal to those of any other specialists, and they need no endorsement from us. Sir William Thomson has just said that America's rank in science is second to none among the nations of the earth, and we may add that the fact is not all due to her theorists and college professors.

The lesson for us is this: What these brilliant ex-operators have done in acquiring fame, and in many instances riches, can be repeated by others. The electrical world—all that vast realm which comprises "the science of the future"—is lying before us; it is constantly widening and deepening, and the younger members of our profession are preparing to take the front rank. No young man engaged in any other ordinary business has a better chance to become a first-class mechanical engineer or mathematician than has the average telegraph operator of ordinary aptitude and patience. All he needs is careful study. We have every evidence that our younger men are studying, and if the progress of the past few years be kept up we may see an operator on the next Electrical Commission.

THE WORK OF THE ELECTICAL CONFERENCE.

Our extended report of the proceedings of the National Conference of Electricians has now been almost all printed, and, taken with the brief sketch of the work done in the closing days, it shows that the addresses and discussions were of great value, and will lead to important results. The attendance was good throughout, a friendly spirit was felt by all engaged, and the only regret on separating was that an opportunity of the kind does not oftener present itself. Perhaps we must now look to the American Institute of Electrical Engineers to take advantage of the interest aroused, and, in the proper manner, as a scientific society, help to carry on and work out the plans laid by the Conference and Commission.

One excellent result of the Conference is the establishment of a decided entente cordiale between English and American electricians. The various able speeches of Sir William Thomson, and of Mr. W. H. Preece, as well as of their companions from the other side, were heard with interest and profit, and it was early apparent, that if any differences existed between Englishmen and Americans on electrical questions, it was not on national grounds, but solely from scientific and practical considerations. This is, of course, as it should be, but even scientific men have sometimes been known to err in the matter. On the whole, the Conference must be characterized as a great success.

THE ELECTRICAL EXHIBITION.

The ring of the hammer of preparation is no longer to be heard in the International Electrical Exhibition, but all the exhibits are in place, and the announcement of completion, together with the arrival of cool weather, is filling the place daily with thousands of visitors. Probably a better time for visiting the Exhibition than the present could not be chosen. If visitors desire to study some or all of the exhibits quietly, we advise them to go in the forenoon or the afternoon, and not alone in the evening, as, although all the machinery is then in motion, the crowds around each exhibit prevent any one from making careful notes and observations. However, if one wishes to know how magnificently a building can be lit by electricity, the evening is naturally the best time to go to the Exhibition. The sight has surprised and delighted everybody.

In point of fact, there is enough in the Exhibition to occupy for several days the attention of even those most familiar with electrical apparatus and instruments. At least half a dozen telephone systems, a dozen electric light systems, over a hundred dynamos, from fifteen to twenty motors of all sizes and about 2,000 miscellaneous exhibits are not to be inspected in a few hours.

THE BESTOWAL OF HONORS.—McGill University Convocation, Montreal, has conferred the honorary degree of LL.D. upon the following prominent members of the British Association in commemoration of its meeting in Montreal: President Lord Rayleigh, the Governor-General of Canada, Sir John A. Macdonald, Sir Lyon Playfair, Sir William Thomson, Professor Bonney, Professor Frankland, Captain Douglas Galton, A. G. Vernon Harcourt, Sir Henry Roscoe, Professor Blanford, Professor Moseley, General Lefroy, Sir Richard Temple, Sir F. Bramwell, E. B. Tylor; also upon the president of Toronto University, Professor Daniel Wilson, Professor Asa Gray, of Harvard, and Professor James Hall, New York State Geologist.

GOOD JOURNALISTIC WORK.—We cannot refrain from congratulating our esteemed contemporary, the Montreal *Witness*, on the admirable manner in which it has reported the proceedings of the British Association during the past two weeks. Its reports and illustrations have been excellent throughout, and we willingly acknowledge the assistance afforded us by the *Witness* in laying before our readers an account of the various electrical papers and discussions.

Printing by Electricity.

It is generally remarked by the visitors to the International Electrical Exhibition that one of the most attractive displays is that of THE ELECTRICAL WORLD, which is now printing a regular weekly edition on the grounds, from electrotypes, by electricity, thus dispensing entirely with type and steam. The hundreds of press notices that have been voluntarily accorded to the journal for its enterprise show that the idea of the exhibit is a happy one, and that it will assist materially in hastening the day when the transmission of power by means of an electric current will be as common and universal as the present distribution of water, or gas, or steam. To demonstrate the feasibility of the application of electricity to printing was our chief aim in making the exhibit, and it is with much gratification that we have received the approval not alone of the thousands of curious spectators, but of the most eminent electricians of England, France and America, now gathered in the city which holds so dearly the memory of Benjamin Franklin, electrician and printer.

We illustrate on this page the main features of THE ELECTRICAL WORLD exhibit. The space occupied is 300 square feet on the main floor on the Lancaster avenue side. It is neatly railed to imitate an electrical circuit, the posts being capped with glass insulators, carrying an electric light wire. The press was made specially for this occasion by Messrs. C. B. Cottrell & Sons, the well-known press manufacturers, of New York and Chicago, having 31x46 bed. It is a fine piece of machinery and stands in the centre of the exhibit. About six feet from it stands a Daft electro-motor of about 1½ horse-power, also built specially by the Daft Electric Light Company, of New York, under Mr. Leo Daft's supervision at the factory, Greenville, N. Y. It is fitted with worm gearing in the same manner as the other Daft motors described and illustrated in THE ELECTRICAL WORLD of August 23, 1884, and has worm gearing, no counter shafting being used. The current is generated by a Daft dynamo located in the east gallery, more than 100 feet from the motor, the dynamo being in turn driven by a Straight Line engine on the main floor below. The whole plant works with the utmost ease and smoothness. Tests will be made and described hereafter. The speed of the press is 1,500 revolutions per hour.

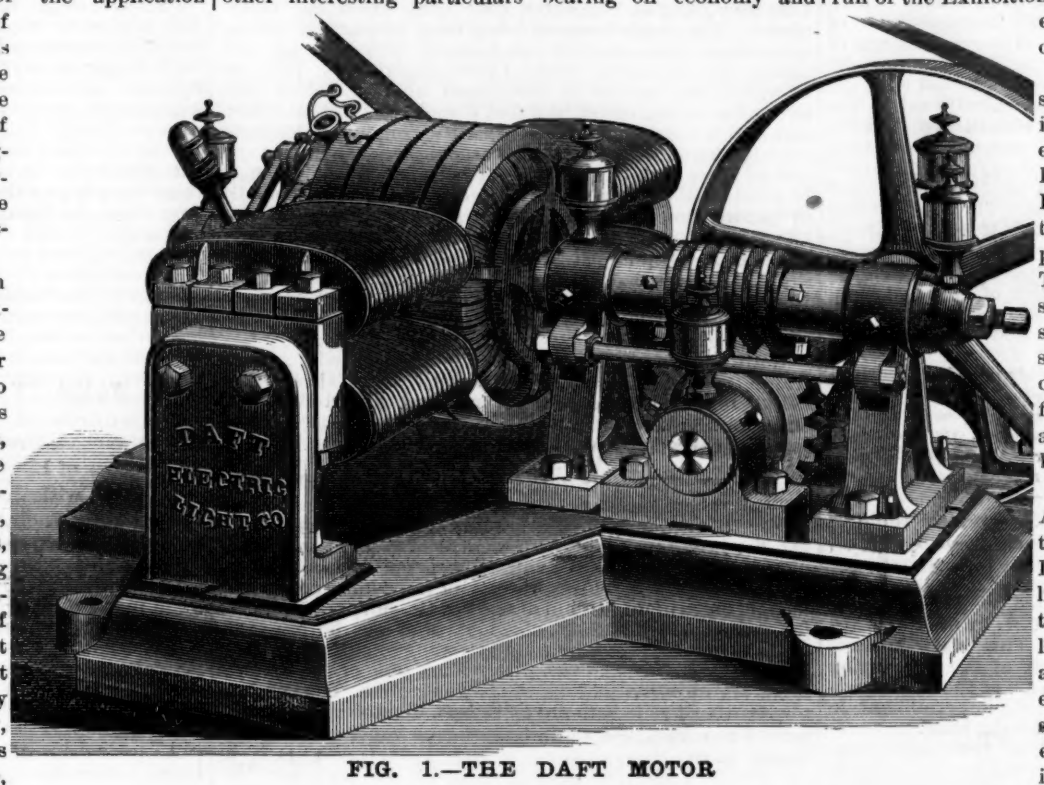


FIG. 1.—THE DAFT MOTOR

Within the same space a fine display is made of all the best electrical books of the day, and orders are received from persons wishing to enlighten themselves as to the nature and applications of electricity. On the handsome showcase containing the books is placed a striking bronze medallion 12 inches in diameter, by Kelly, of New York, representing Mr. Thomas A. Edison experimenting with his early, crude phonograph. This has been loaned to THE ELECTRICAL WORLD by the New York Press Club.

Another special feature of the exhibit is Capt. Lina Beecher's portable telephone apparatus, by means of which communication can be had between any two moving points widely apart, such as two ships, a boat and a ship, or between a moving train and any station, between bodies of troops in motion, etc. This exhibit is receiving considerable attention from both army and navy officers, who see for it a great future, not alone in commerce, but in warfare by sea or land.

While the press is in motion during the day and night, large crowds surround the space, and copies of the paper are bought by the hundred as they leave the cylinder, as scientific curiosities; and the Business Manager is besieged for information regarding the *modus operandi*, cost and other interesting particulars bearing on economy and practicability. Printers find the exhibit very interesting, and ask many questions.

Press Notices of the Exhibit.

The number of press notices given to the exhibit of THE ELECTRICAL WORLD at the International Electrical Exhibition has been remarkable.

The Philadelphia *Times*, Aug. 28, says: "One of the most interesting and most enterprising exhibits is that of THE ELECTRICAL WORLD. A Babcock & Cottrell printing press, 31×46 inches, will soon be in place. This is to be supplied with motor power from a 2 horse-power Daft motor and dynamo. The press, motor and dynamo have been specially built for this exhibition. It is intended to print and publish every week a complete edition of THE ELECTRICAL WORLD."

The Philadelphia *Record*, Sept. 2, says: "These lectures will be printed in THE ELECTRICAL WORLD, which will be one of the most interesting features of the Exhibition. This paper will be printed in the main building upon a press run by electricity."

The Philadelphia *Times*, Sept. 5, remarks: "The first really interesting object is the printing press of THE ELECTRICAL WORLD. This press is run by a Daft motor supplied with a current by a Daft dynamo in the south gallery, which is fed by one of the odd-looking Straight-Line engines standing near the press."

The *Philadelphia Times*, Sept. 6, notes as follows: "The first newspaper printed by electromotive power was produced yesterday. Four thousand copies of THE ELECTRICAL WORLD were struck off, and the business manager of the paper says he will continue to print every day during the run of the Exhibition. The press runs very easily and the electro-dynamic force is perfectly successful."

The New York *Tribune* of Sept. 8 says: "One of the most practical illustrations of the transmission of electric energy shown at the Electrical Exhibition is in the exhibit of THE ELECTRICAL WORLD, the entire edition of the paper being printed on a press propelled by an electric motor. The current is generated by a dynamo situated in the gallery on the west side of the building, and is carried several hundred feet over an insulated copper wire to the motor on the main floor. The press is belted to the motor, and has a capacity of 1,500 copies per hour."

The following was sent out by the Associated Press, and appeared in all the papers served by it: "THE ELECTRICAL WORLD, a paper published in New York, and devoted to the science of electricity, has established a branch office in the building, and will print THE WORLD here by electricity as long as the exhibition shall be open. THE ELECTRICAL WORLD exhibit thus forms one of the most interesting, the newspaper being printed without steam, the cylinder press being run by a Daft motor."

The Chicago *Times* has this: "One of the very latest novelties is a printing press run by a small Daft motor, on which THE ELECTRICAL WORLD is now printed. This is the second paper to be printed by electrical power, and the enterprise is much to be commended."

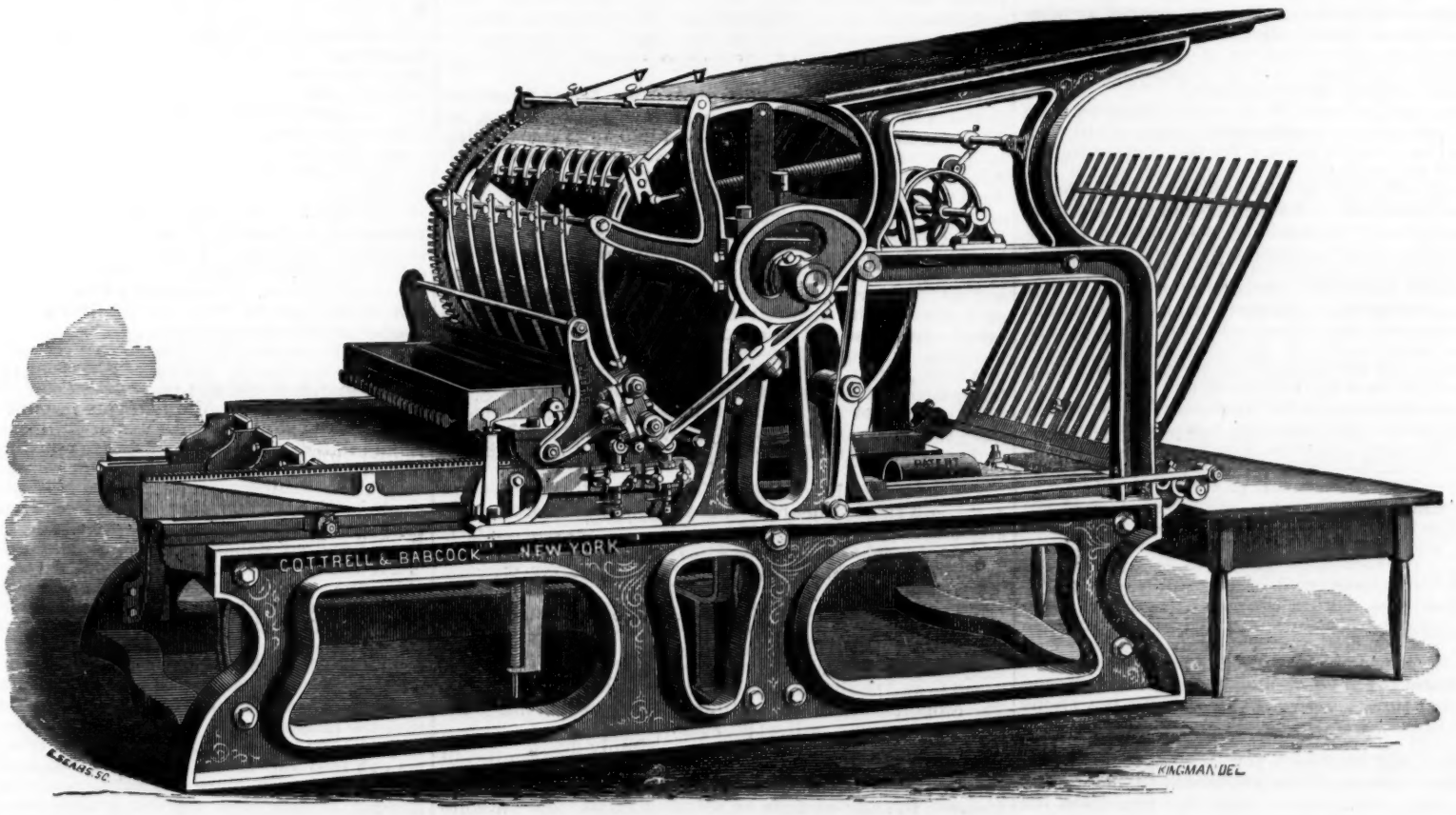


FIG. 2.—THE COTTRELL PRESS.

Dr. St. Clair's Surgical and Dental Electric Lamp.

In the space occupied by THE ELECTRICAL WORLD at the Electrical Exhibition may be seen some minute incandescent electric lamps, and the accessories therefor, made by R. M. St. Clair, M. D., of Brooklyn, N. Y. These articles are of great interest to the physician, surgeon and dentist, as well as to the public, who will be benefited by their use in diagnosticating the diseases flesh is heir to.

The lamps are of very ingenious construction, and their operation is watched daily by hundreds of visitors, including many dentists, surgeons and other professional men.

The Desilverization of Lead by Electrolysis.*

Mr. President and Gentlemen: It seems proper, before I describe the plant which has been erected at Rome, N. Y., for the purpose of demonstrating the practicability of my process of refining and desilverizing lead by electrolysis. to state in a few words the principles which govern the process. They are well known to those who have studied electrical science. They are known to the electro-platers of the country, and they are briefly this:

If we take a plate or other form of metal (impure lead in this case) and immerse it in a bath consisting of a solution of the main metal (that which contains the impurities) and also immerse another plate, which shall be a conductor of electricity, in the bath, but separated from the first by the solution, and connect the former plate with the positive pole of the source of electricity and the other plate with the negative pole, an action will go on in this bath which is called electrolysis. There is first a decomposition of the solution constituting the bath. Then a solution of the metal at the positive pole called the anode, and a deposition upon the other plate connected with the negative pole, and which plate is technically called the cathode. If this solution is properly constituted, and the current of electricity which is passed through the bath is of the proper strength and electro-motive force, the dissolution of the anode and the deposition of the metal upon the cathode will be exactly equivalent. The analysis and the synthesis are opposite and equal. If this solution, called an electrolyte, be not properly constituted, decomposition will go on, but there will be these effects, a superoxidation at the anode and a deposition of free hydrogen at the cathode, which free hydrogen escapes finally in bubbles through the liquid to the surface and into the atmosphere.

In the electrolytic treatment of metals simply for their purification and recovery, it is important that the electrolyte should be so constituted that nothing will be dissolved from the anode but that which is to be deposited upon the cathode, and the action should take place in exactly equivalent quantities. In this case, for a given weight of lead dissolved from the anode, a given weight of lead should be deposited upon the cathode. If not so, there is a waste of electrical energy in the deposition of hydrogen, which escapes to the atmosphere. There is a decomposition of the electrolyte; oxygen is freed at the anode and suboxides and subsalts are there formed, which finally act to cut down the current of electricity, or, in other words act contrary to the electrical energy. This action is, therefore, not only uneconomical in the way of the production of the metal, but uneconomical by reason of the decomposition of the electrolyte, which should remain permanent in its constitution to avoid expense, to say the least.

With these principles in view, several years ago I commenced a series of experiments, and the fact is probably familiar to the most of you through papers which have been published from time to time in journals and in the proceedings of the Institute. These experiments were for the purpose of demonstrating the practicability of treating that material which is produced in such abundance in this country, *lead base bullion*. In the pursuit of this investigation I tested many solutions, or electrolytes, and finally settled upon this one: a solution of acetate of soda in which is dissolved sulphate of lead. The chemical reasons I need not enter into here, but suffice it to say the dissolution of the lead from the anode and its disposition upon the cathode are exactly equivalent. This was arrived at after trying many solutions which, after a time, were found to suffer decomposition. This solution, after many months and years of trial, has been found to be perfect in respect to sustaining its integrity of constitution.

A few months ago at Rome, N. Y. was commenced an experimental plant on a considerably larger scale than anything I had undertaken before, for the demonstration to capitalists of the feasiblity of this process, which had been thoroughly endorsed by those who are electrically informed in such matters. "When I commenced the experiment years ago, electrical science and appliances for the production of electricity economically had not reached the advanced stage as at the present. Now we seem to approach very nearly perfection, because we are able to convert mechanical energy into that form which we call electrical energy with very slight loss. Dynamo-electric machines are used which return in electrical energy 84 to 96 per cent. of the actual mechanical energy which is applied to them by the belt from the steam engine

I will now describe simply the steps of the process to which the base bullion is submitted at this establishment in Rome, giving merely a short description of the main apparatus and leave the electrical and chemical considerations of the process to some future paper.

You are all familiar with base bullion, so I need not describe it. The metal is brought in pigs to the plant and is taken to a reverberatory furnace having a hearth of a bowl shape. At the bottom of the hearth is an iron pipe leading through the outer wall of the furnace. At the end of this iron pipe, within the bowl, there is a valve which opens inward by means of a rod passing through the pipe. The metal melted there is submitted to the action of a reduction flame produced by wood. About ¼ of a cord of hard wood is burnt in ten hours, and ten tons of bullion may be melted in that time. Alongside the furnace is a frame which carries 12 molds. These molds are made to cast plates of bullion of the size 24 × 6 × ½ inches. This frame is annular, and runs upon rollers along the side of the furnace, so as to bring the molds, which are placed vertically on the ring, in succession under the pipe from the furnace. As each mold is brought to place an attendant moves the valve to draw enough of the metal to fill it, and so on in succession. As the frame is rotated, other operatives open the molds by turning down one side of each, and remove the plates; but, before closing the molds, they put in some perforated copper ribbon pieces, which may be seen in this exhibit upon the top of the plate. They are used for the suspension of the plate.

The molds are then closed and they pass on to be again filled in due succession. After extended practice, the operatives cast five of those plates per minute. Each weighs 7.6 pounds on the average, so that we get 38 pounds of metal cast per minute, or a little over a ton per hour. The plates are then taken by other operatives and hung temporarily by the copper strips on hooks, while a muslin bag is drawn over each plate from the bottom upward. As the lead is dissolved from the plate, there remains a residue, consisting of the impurities of the lead, which are antimony, arsenic, copper, iron, silver, gold and other metals. This residue would otherwise drop to the bottom of the vat and become mixed with the lead. The office of the bag is simply to retain the residues. After the bag is drawn upon the plate it is taken and hung upon what is called the anode frame. This frame consists of six radial arms, fastened to a central cast plate. Upon the outer ends of these arms there are rollers. The whole frame is a little over 6 feet in diameter. On the under side of these wooden arms are copper conductors, placed radially so that their inner ends are in close contiguity. To the conductors on the under side of this anode frame are fastened twelve concentric rings, two inches apart, and upon these rings are metal hooks, for the purpose of receiving the plates of bullion when hung by these copper strips. This anode frame holds 276 of the plates so that they hang on concentric ring-forms from the frame above. The anode frame is lifted from its place of rest by a traveling crane, carried and lowered into the vat containing the electrolyte which I have described. This vat, of which there are 30 in this plant, holding each a little over a ton of the metal, is 6 feet 1 inch in internal diameter and is constructed of an asphaltic cement upon an asphaltic floor so as to make it water-tight. There is a system of pipes or conduits for the electrolyte so that it may be conducted to each vat as desired. Thence it continually overflows the edge of the vat into gutters or conduits between the vats and returns to an underground cistern, whence it is pumped to an overhead cistern which supplies a head to force the solution to enter the vats. In that way we obtain a continual circulation of the solution, which is necessary both electrically and chemically.

Within these vats there is placed what is called a cathode frame. This cathode frame is built up of 13 sheet brass cylinders placed concentrically, two inches apart. When the anodes are lowered within the vat they pass between the separate cathode plates, so that a cathode plate is upon either side of an anode plate, and about one inch removed therefrom. The electrolyte which I have described fills the vat. These vats are so connected with the source of electricity that the current passes from a dynamo machine into vat No. 1, and up through the centre of a core 2 feet in diameter, built within the vat. This is built within the vat for two purposes: First, to sustain the copper conductor which passes up in its centre and for the purpose of filling the centre part of the vat, since it would not be practicable to bring the plates in annular arrangement around the centre any closer than two feet. Each one of these vats holds six hundred gallons of the electrolyte. The conductors leading to the vats are of 1½ inch diameter round copper. From the inner periphery of each vat a copper conductor passes through the side and down underneath to the centre of the succeeding vat, and so on over the whole series of 30. The dynamo used is one made by Mr. Edison for the purpose. It furnishes an electric current having a difference of potential or an electromotive force at its binding posts capable of rising to six or seven volts, but in practice we use the current up to 2½ or 3 volts. The current which it supplies can be varied to suit the requirements of the case, but has been made as great as 1,400 ampères, and from that to a thousand and below; but the production of lead is in exact proportion to the ampères of current. One thousand ampères of current passed through these vats enables us to dissolve this lead and deposit it upon the cathode at the rate of 8.5 pounds per hour in each vat, so that we succeed in treating one ton of this bullion in each vat within the period of ten days of twenty-four hours.

The bullion requires no attention after being immersed in the vat, except the one of occasionally turning it This can be done by means of the anode frame having rollers upon the outer ends of the arms as described, which roliers rest upon the edges of the vat. This turning is done for the purpose of preventing what is called short circuits. The lead is deposited upon the cathode in this form (indicating), very crystalline we may say, and in feather-like crystals. These build out from the cathode toward the anode, and in a short time would build across, so that the current of electricity, in preference to taking a path through the electrolyte would pass directly by the metal, and we would cease to gain any dissolution or deposition. This operation of turning is now done by means of a lever, but it is in contemplation to have the movement take place continuously by mechanical power.

After the lead is about all dissolved—some 5 per cent. is left—the anode frame is lifted out, the bags are removed, and the residues are washed out into a vat by means of water.

The particular lot of bullion from which this exhibit was cast has, I think, some 125 ounces of silver per ton and about half an ounce of gold.

There are other impurities which have not yet been determined by analysis, but the residue is a little over one and one half per cent. of the whole material.

After these residues settle to the bottom, the water is drawn off by means of a siphon, and they are mixed with nitrate of soda in proper proportions and fused. As a result, the gold and silver are found at the bottom of the crucible and the other metals are retained within the slag. The economic separation of these other metals, like antimony and arsenic, will be pursued.

I have here some of the residue, simply dried. It will be found to be a black, impalpable powder, but at the same time of sufficient coarseness, we may say, not to pass through the bag, and can be readily filtered from the solution through coarse twilled muslin.

The plant, as laid down, has demonstrated the feasibility of the plan. It has been found somewhat imperfect, but has determined all the questions which have arisen relating to the economic treatment; and other vats will be built to avoid the mechanical difficulties which we have encountered. The main difficulty is one of leakage. Unfortunately the vats were placed upon an imperfect foundation, and from the weight of the solution, the metal, etc., they have settled somewhat unequally and cracked, so that we unavoidably lose considerable solution through the ground below. It is contemplated hereafter to place the vats upon a substructure of timber that will enable us to get at the bottom and secure any leakage, if such arise. Perhaps no leakage would have occurred in this case if the foundation had been properly constructed.

DISCUSSION.

J. H. Roney: I would like to ask one or two questions, and those are: 1. Whether there is any perceptible leakage of the residue through the muslin bags into the bottom of the vat. 2. Whether any of that residue is carried over mechanically in pumping the liquid to the overhead system, in order to keep up a constant circulation, for the purpose, I suppose he means to convey, of obtaining a solution of the same density throughout. 3. Whether, in the leakage which he speaks of there is any loss of electrical energy transmitted to the earth.

Mr. Keith: The question of mixing of the residues by passing through the bag has been thoroughly worked out, and we find that practically there is none. If these plates with the bags over them had to be handled in any manner, some of the residues would be forced through the bags. But they are not handled; they are simply moved around through the solution, and we find no wash of the kind. What is rather remarkable, the residues remain upon the plate until it is completely dissolved. When the plate has been reduced to the thinness of thin writing-paper, it still retains its original thickness, and almost its original external appearance; but the moment you touch it with finger or anything, it sinks. This black, pasty-like material can be easily drawn off, so that simply the lead is underneath, without any other coating. The motion of the anodes through the fluid does not mix the residues. Even the upward movement of the solution does not carry anything over the top of the bag, because the bag is drawn somewhat higher than the top of the plate, and is suspended just above the top of the solution. Even if it is suspended below the surface we find no admixture.

There was one point that I omitted to speak of, and that is the collection of the lead. When these anodes are moved around in the vat there are scrapers which hang from the arms down between the cathodes, and these scrape off the lead crystals deposited upon the cathodes and drop the crystals into the bottom of the vat. The purpose of the bag was to prevent the admixture of purified lead with the impurities from which we had separated it. When cleaning-up time comes we draw off the solution over the top by means of a siphon, and at the same time lift out the anodes and then the cathodes. We then shovel out this deposit of lead, such as I have shown you in the bottle, and such as you may see in very much larger quantity in an exhibit at the Electrical Exhibition. This crystalline lead remains, while under the solution, in a perfect metallic form. That in the bottle which has been passed around is under some of the solution. The solution is as clear as water, and the lead will remain under this solution perfectly unaffected by oxidation or any other apparent action for an indefinite length of time. I have some now which I have thus kept in a bottle for over six years, and it is as bright to-day as it was at the beginning. This in itself shows that there is no chemical action going on in the solution, except under the conditions of the treatment.

As to leakage of current, we found at the commencement, before the vats were filled with liquid, and before they commenced to leak, that there was practically no leakage of current under the electromotive force which was used. But since that time there is a slight leakage, but practically of no account. This is an electrical point which I intend to bring before the Institute of Electrical Engineers, because it is rather more within the scope of their course of investigation, and there consider it. The leakage, I may say, is practically *nil*. The amount of horse-power which is consumed in the separation of this material is merely nominal, we may say. The difference of potential at the binding posts, or the electrodes of the vats, is scarcely one-fourth of a volt. The current passing through is 1,000 ampères. This one-fourth of a volt and one thousand ampères is produced at less than one-half of a horse-power. The main consumption of energy is in overcoming the resistance of the conductors between the source of electricity and the vats themselves, and that of the conductors between the vats. For instance, the longest single piece of conductor is 28 feet, of 1½ inch round copper rod between the dynamo and the first vat. My measurements show that one-sixth of the energy which is passed into this external circuit is consumed in that particular conductor. So small is the electrical resistance of this conductor that it would be called in ordinary electrical measurements—such electrical measurements as prevailed a few years ago—*nothing*. But nowadays we have to deal with the one-millionth part of an ohm in resistance.

R. W. Raymond: Mr. President: The merits of this process, as concerns the purity of the lead produced are of course unquestioned and unquestionable. The drawbacks of the process, economically, appear to fall in two classes:

First—The slowness with which it proceeds causes the accumulation at one time of a large quantity of valuable material in the works, which in turn requires the use of a very large floating capital. Where this material is high-grade bullion, the number of tons in the works at any one time would represent a sum probably averaging two or three hundred dollars per ton in gold and silver values alone, to say nothing of the lead. All that requires an extensive plant, though the plant in this case seems to be more extensive than expensive, so that this cannot be reckoned among the most expensive forms of mercantile apparatus. On the other hand, my attention was struck by Mr. Keith's declaration that the production of lead was in precise proportion to the ampères or quantity of current—a familiar thing to us blast furnace men, who know that the production of iron is in precise proportion, if we may use the expression, to the number of ampères of wind we put into the furnace. And as we have increased the capacity of our blast furnaces, producing double the amount of iron from the same plant simply by blowing harder and more, the question arises in this case whether, with a given plant, the rapidity of production can be increased by simply increasing indefinitely the quantity of current. If Mr. Keith's works, using a thousand ampères, produces for each vat a ton in ten days—

Mr. Keith: About 9 pounds, I think, to the hour.

Then would it be possible for him by doubling the quantity of electric current to produce double that amount of lead, or to treat double that amount of bullion.

The second objection to this process is more or less an economic one. The process furnishes us with very pure lead, but it furnishes us with about the most disagreeable thing to get gold and silver out of that a metallurgist could well devise; and the treatment of these residues with nitrate of soda is a crucible laboratory process not particularly attractive to us as a means of separation of gold and silver on a large scale. I want to know from Mr. Keith on that head, what the practice is, so far as his experience has determined it under this process in the matter of the separation of the gold and silver. The fact that we get all

*A paper read by N. S. Keith at the Philadelphia meeting of the American Institute of Mining Engineers, Philadelphia, Sept. 3, 1884.

or nearly all the lead pure is excellent, so far as that goes; and because also it may be done with so great cheapness and regularity and with so little skilled labor, makes the process compare favorably with the ordinary process of zincification. But whether there is loss of the gold or silver, whether there are other by-products produced, whether the slag that comes from the crucible in which the nitrate of soda has been used is by itself worth anything, whether we are obliged to follow remnants of gold and silver down through that waste material for further determination—all these questions must be answered before we can sum up the advantages or disadvantages which this process possesses, and fix on the side on which the advantage inclines.

I fancy it would turn out that, like most other metallurgical processes of acknowledged merit, it will be economical under some circumstances and conditions, and in certain localities, whereas in other localities and under other conditions it could not perhaps compete with the present pyrognostic process.

Mr. Keith: I desire to convey this impression, that this plant is an experimental one, but an experiment upon a large scale. Every point which we have met has been practically decided. The question of the separation of the residues to their ultimate constituents has not been fully determined, but the slags which are produced are very fluid ones. The separation of the gold and silver, so far as our tests have gone, seems to be complete. The economic separation of antimony has been thoroughly considered, but not carried into practical effect. There seems, so far, to be very little, if anything, against it, under theoretical considerations.

As to the minimum of plant with respect to the amount of material which shall be placed under treatment, I will say this, that the process has been carried on at the rate of dissolving these plates in 2½ days or 60 hours. The action is still as effectual, and that economical point may be considered settled upon this basis, if it be dissolved in ten days, or 240 hours, by the application of a due proportion of power, having simply the question of the conversion of that power into electrical energy (which can be done unquestionably, and is done daily), this material may be dissolved in 60 hours. That diminishes the size of the plant very materially. It was not thought necessary in this plant to go to that extent, but the experiments which have been carried on, and to which no practical objection has been urged by those who are experienced in such matters, settles that point.

There was a time in the first publications of this process that it was considered by myself impracticable to dissolve this bullion at a greater rapidity than in about eight days, for this reason: If the solution is not properly circulated and does not filter through the bag so that the lead may be dissolved through the electrolytic action by the acetate of soda solution and carried from the bag into contact with the cathode, the operation will become one of decomposition; there will be a formation of a crust of sulphate of lead which will not be dissolved, and finally act with such strength counter to the electric force as to stop the current entirely. But with the means which we have taken and which I have described for producing ample circulation, the possible rapidity of the process has not yet been determined, except that it can be finished in 60 hours with plates of that thickness.

Now, as to the cost of production of these plates and the putting of the bags upon them and hanging them upon the anodes, it is somewhere between 90 cents and $1 per ton under the arrangements which I have described. The power applied is about 12 horse-power, and, as I have said, fully three-fourths of this is absorbed by the conductors themselves, which it was thought were made large enough. They are large enough if we consent to expend energy day by day in overcoming their resistance. If we conclude it is better to increase their size and therefore decrease the daily consumption of energy and its attendant expense, we will also decrease the expense of the production of the current.

M. B. Patch: I would like to ask Mr. Keith whether there is any difference in the amount of lead deposited resulting from any difference in the speed with which the solution is allowed to flow in and out of the vat. For instance, it makes a great difference in blast furnaces what force of air goes in to make your combustion perfect.

Mr. Keith: The amount of lead deposited is exactly the same in all the vats. If there is any obstruction in the circulation of any vat, it cuts down the production of lead in all the vats. We have overcome all such obstructions due to defective circulation. This solution is replaced at the rate of 600 gallons each hour and a half. It can be done a little more rapidly. We find by electrical tests that if it is done more slowly there is a greater tendency to the production of counter electromotive force or resistance to the passage of the current and the consequent cutting down of the product.

Somewhat analogous to bringing oxygen in immediate contact with the fuel as fast as the carbon may absorb it, so we want to bring the lead which is in the solution in contact with the cathode so that it may be deposited. If no lead is there present, no lead will be deposited, and the current is resisted at that point. The tendency is to take the material which is present rather than the one which should be present. It takes more energy to deposit certain constituents of the solution than it does the lead constituent. If lead be not present, it requires more energy to deposit hydrogen, that being the only other material, If zinc happened to be in the solution, it would require more energy to deposit that zinc. If there is a proper amount of the lead, no zinc would be deposited; and, conversely at the anode, as long as lead is present, no other metal is dissolved, with the exception of zinc, if it be present.

TELEPHONE TAXES.—A dispatch of Aug. 30, from Cincinnati O., says: It is claimed that the instruments of the Bell Telephone Company have not been listed for taxation here for four years The instruments are the property of the American Bell Telephone Company, and are leased to the local company at the rate of $20 per annum for each instrument. Telephone officials have been cited to appear before the county auditor on Friday next.

A SERIOUS GAS EXPLOSION.—The number of gas explosions and of fires caused by them, has been very noticeable of late. On Sept. 4 the wholesale drug house of W. N. Wilkerson & Co., at Memphis, Tenn., was destroyed by fire. The loss on the building and stock was $85,000. The fire was caused by an explosion of gas in the cellar.

Mechanical Telephones.

It would be interesting to know the number of mechanical telephones now in use in this country. Abroad, there does not appear to have been much of a demand for them, but here their employment is decidedly on the increase. A great many people want telephonic connection who do not wish to enjoy also the advantages of an exchange system, and a great many more to whom a set of telephones is a great benefit are unable to pay the regular charges for use of the Bell apparatus. There are thousands of instances in which a business man will have his house or town office one or two miles from his mill or factory, but it is necessary that the two places should be in constant communication, and here the mechanical telephone finds its chance. Numerous cases also exist where communication of an easy and prompt nature is required between various parts of a scattered establishment—say an iron foundry—or between different floors of the same building, and here again the mechanical telephone is often serviceable.

We illustrate herewith the apparatus now sold by the Consolidated Telephone Company, 18 Broadway, New York. It will be seen that provision is made for hearing and speaking, without any troublesome movement of the head. The mouth can be kept at the diaphragm all the time, and the replies from the other end pass through the flexible tube to the ear. The instrument is fitted with a magneto bell, so that either end can be called up instantaneously or prearranged signals be sent. The apparatus will be found ornamental in any office, and the results in practical use have been generally of a most satisfactory nature. The Consolidated Company was organized in May, 1883, and has been busily occupied since then introducing its mechanical telephone, protected by no fewer than eight distinct patents. The three merits claimed for the system as now operated are, economy, safety and distinctness of enunciation. The diaphragm of the transmitter is made of a specially prepared silk fabric, dressed with a strengthening

THE CONSOLIDATED MECHANICAL TELEPHONE.

solution. The wood-work is of highly finished black walnut. The magneto bell can be of any good kind. The company invite attention to their system as eminently successful in short-distance telephony. The New York lessees are the New York Telephone & Telegraph Co., and territorial rights can be secured on application, if not already allotted.

THE RIGHT TO USE STOCK INSTRUMENTS.—Argument has been heard before Judge Van Brunt here on a motion to dissolve a temporary injunction obtained against the Gold & Stock Telegraph Company by Ellis Morris, restraining the company from removing from the plaintiff's office a stock instrument. The company alleges that Morris violated his contract in giving the information as to prices of stock, etc., to others, and that his business was the running of a "bucket shop" where bets were made on the fluctuations of the market in violation of the gambling law. This the plaintiff denied. Judge Van Brunt refused to dissolve the injunction and said the company had failed to substantiate its charge.

RATES FOR THE SYNCHRONOUS-MULTIPLEX.—The following is the schedule of rates adopted for the Delany-Calahan system, now working between Boston and Providence: For messages to be delivered by the company's messenger to any point within one mile of the post-office in either city, twenty-five words or less for twenty cents; each additional word up to fifty, one-half cent per word; for all words over fifty, one-quarter cent per word. For messages to be stamped and properly dropped into the post-office for delivery by carrier in either city, ten words for ten cents; each additional five words or fraction thereof, one cent. For messages not exceeding ten words, to be written on a postal card at the receiving end and dropped into the post-office for delivery, five cents.

THE ERIE COMPANY.—The directors of the Erie Telephone and Telegraph company held an adjourned meeting Monday afternoon, says the Lowell *Citizen* of the 9th. Six directors were present, and the company's affairs were discussed in a most harmonious manner. Whatever may have been said regarding dissension among the directors of the company has been greatly exaggerated, without doubt, if yesterday's meeting is to be taken as a criterion. The reports from the various divisions are all of an encouraging nature, and the future of the company never looked more flattering. The affairs of the company are to be carefully looked over at the headquarters of each division and at the exchanges, and everything in the way of economy and general management will be done to improve and strengthen the company.

American Association Proceedings.

In spite of the tremendous and exhausting heat last week, the American Association accomplished a great amount of work before it adjourned on the 11th. In advance of more extended reports, such as those published in these columns last week, it may be mentioned that on the 8th, in the physics section, H. A. Hazen read a paper on "Thunder-Storms and their Relation to 'Low,'" and H. W. Eaton one on "Some Relations of Positive and Negative Electricity." On the 9th in the same section, Mr. A. Graham Bell made a brief but exceedingly interesting and important statement upon a possible means of electrical communication between vessels at sea, by means of a telephone cutting the lines of force created for the purpose by dynamo machines on board both. A code of signals could be compiled, and by this means additional safety would be given to ocean travel, as ships would know when they were near each other, or near land. On theoretical grounds, the idea is sound. Prof. Trowbridge, president of the section, called attention to what he regarded as a plausible and possible, if not a practical, method of sending signals across the Atlantic without a cable, by the aid of earth-plates fixed in Greenland and at the southern extremity of South America. Mr. W. H. Preece, electrician to the British Government, followed in a description of experiments made by himself between the Isle of Wight and the mainland, when telephonic communication was maintained across two arms of the sea, one being six and the other one and one-quarter miles in width. He contended that these experiments proved that it was quite possible to maintain communication by means analogous to those described by Prof. Bell.

A technical discussion was had on the Fritts' selenium cells and batteries. Papers were read by E. H. Hall on the "Magnetic Rotation of the Equi-Potential Lines of Electric Currents in Various Metals and Alloys;" by M Baker on a "Proposed Method of Determining the Magnetic Dip by Means of a Magnetic Pendulum;" and by Sylvanus P Thompson on a "Standard Tangent Galvanometer."

On the 11th in the mechanical science section, Mr. Crampton of England gave a description of the cable laid under the English Channel thirty-three years ago, under his supervision. The following papers were read: "Giants' Causeway and Portrush Electric Tramway," by W. H. Traill; "Electric Tramways," by W. H. Smith; "Economy of the Electric Light," by A. Stirling; "Dillon's Automatic Sounder," by Mr. Dillon. In the section on physics Sir William Thomson and Prof. James Dewar, of the British Association, were prominent in the discussions. The former gave a technical explanation on "The Distribution of Potential in Conductors Experiencing the Electro-magnetic Effects Discovered by Hall." Professor Dewar lectured on "Electric Discharges in Relation to the Equilibrium of Gaseous Atmospheres." The other papers read were by G. W. Hough, on "An Absolute Sensitometer;" Sylvanus P. Thompson, on "A Standard Tangent Galvanometer" and on "The Government of Electric Motors."

On the 11th, the business of the various sections was cleared up.

Professor Minot, from the committee to confer with committees of foreign scientific bodies upon the scheme for an International Scientific Association, reported that the scheme was favorably considered by all parties concerned, and presented a series of recommendations for the initiation of the work of organization. The report was adopted, and the committee continued with power to carry out the plan proposed.

Professor Morse, from the Committee on the Duty on Scientific Books, said that he had every reason to feel assured that great relief may shortly be expected from the government in the importation of scientific books to be used in colleges and institutions of learning.

Acting President Cope again condemned the action of Congress in this matter, and observed that the tax would fall most heavily upon private students, who were less able to pay big prices for the books than the colleges.

The fact that the Committee on the Best Methods of Teaching Science in the Public Schools had made no report, provoked a few sharp remarks from Professor Thurston, who moved that the committee be continued and reorganized so as to render the original intention of the association capable of fulfillment.

Professor MacAlister, superintendent of public schools of the city, and others, supported this motion.

A delegate proposed to postpone action upon the motion, but his amendment was defeated and the original motion was passed.

A formal conference was held next day at noon in the green room of the Academy of Music between citizens of Philadelphia and members of the Executive Council of the International Inventions Exhibition to be held in London next year. Sir Frederick Bramwell, chairman of the Council, explained that the preliminaries of the exhibition were already matured. Its site would be the same as that of the Fisheries and the Health Exhibitions in South Kensington.

Addresses were made by Professor James Dewar, of London, and others. John Wanamaker, of Philadelphia, and members of the American Association gave assurance of their intention to heartily co-operate in sending a creditable American exhibit.

National Conference of Electricians.

(SECOND DAY, SEPT. 9.)

The Conference was called to order on Tuesday, 9th inst., by the President, Prof. Henry A. Rowland, who introduced Prof. Abbe to speak on the work of the U. S. Signal Service in relation to Atmospheric Electricity and Earth Currents.

REMARKS OF PROF. ABBE.

Before I speak of the actual work going on in the U. S. Signal Service, I have the following letter to read at the request of the Chief Signal Officer. Myself and confreres have the honor to lay before you the inclosed documents and copies of letters recently received by him through the State Department, relative to the simultaneous use of the same wire for telegraph and telephone communication. These documents not belonging to our business, we have, with the consent of the Chief Signal Officer, asked that it may be referred to the Conference, to be referred by it to a committee, to be reported upon at the proper time.

PHILADELPHIA, Sept. 8, 1884.

Prof. H. A. Rowland, President U. S. National Electrical Conference:

SIR: At the request of the Chief Signal Officer, Gen. W. B. Hazen, we have the honor to lay before you the inclosed documents, being copies of letters recently received by him through the State Department relative to the simultaneous use of the same wire for telegraphic and telephonic communication. Gen. Hazen would be pleased to have the views and the experience of the electricians of this country as to the general practicability of Mr. C. Langdon Davies', or any other scheme, for this double use of the same wire.

Hoping that this communication will be considered worthy of a report by a committee of experts in telegraphy and electricity, we remain, very respectfully, yours,

CLEVELAND ABBE,
Delegate from the Chief Signal Office, U. S. A.

DEPARTMENT OF STATE,
WASHINGTON, June 3, 1884.

The Hon. Robert T. Lincoln, Secretary of War:

SIR: With reference to the inclosed copy of a despatch to this department concerning the International Electrical Conference, held at Paris in April last, I have the honor to call your attention to Resolution 2d as to electrical currents and lightning conductors, and to inquire whether the Signal Office of your department can take charge of the annual observations requested by the conference.

I have the honor to be, sir, your obedient servant,

(Signed) FRED'K T. FRELINGHUYSEN.

Inclosure, Mr. Morton to Mr. Frelinghuysen, No. 554, May 5, 1884. Copy.

A true copy.—LOUIS V. CARVIARC, First Lieutenant, Second Artillery, Acting Signal Officer, June 10, 1884.

110 CAMERON STREET, LONDON,
July 17, 1884.

TELEPHONE-CUM-TELEGRAPH.

SIR: My recent researches have resulted in the production of a system of simultaneous telephony and telegraphy, which is free from the grave disadvantages associated with other attempts to accomplish the same object.

My Telephone-cum-Telegraph does not require the graduation of the telegraph currents, the introduction of resistances into the wires, the increase of the batteries, or any other interference with the telegraphic installation as it now stands. Not only is it unnecessary to introduce such impediments into every wire in the vicinity carrying electric currents, but I do not even introduce them into the wires I use for the telephone.

Without modifying or interfering with the telegraph wires, batteries, currents, instruments or accessories, perfectly indifferent to any number of neighboring wires employed in the transmission of electric currents (whose induction I shut out of my instruments), I have in an experiment of six weeks' duration, held clear and distinct communication by telephone between London and another place in England, *on the existing telegraph wires*, simultaneously with the passage on the same wires, and on numerous other wires attached to the same posts, of telegrams transmitted by means of numerous forms of telegraph instruments, from the simplest to the most complex, including even Wheatstone automatic mediums working at a speed of 240 words a minute.

I am now ready to make experimental demonstration of any system on the wires of telegraph administrations interested in adding telephony to all the services which the existing telegraph wires are capable of rendering.

I am, sir, your obedient servant,
C. LANGDON DAVIES.

LEGATION OF THE UNITED STATES,
BRUSSELS, 20th of July, 1884.

SIR: Referring to my No. 66, of December 8th, 1882, I have the honor to transmit herewith a printed letter received from Mr. C. Langdon Davies, of London, from which it appears that he claims to be able to hold clear and distinct communications by telephone between London and another place in England, on the district telegraph wires—simultaneously with the passage on the same wires and on numerous other wires attached to the same post, of telegrams transmitted by numerous forms of telegraph instruments from the most simple to the most complex.

Believing that this may be of interest to the Secretary of War, I have the honor to bring it to your notice, and to be, sir,

Your obedient servant,
NICHOLAS FISH.

Inclosure. Mr. C. Langdon Davies to Mr. Fish, 17th July, 1884.

The Hon. Frederick T. Frelinghuysen, etc., etc.

DEPARTMENT OF STATE,
WASHINGTON, Aug. 12, 1884.

The Hon. Robert T. Lincoln, Secretary of War:

SIR. Referring to the letter of your department, of August 8, 1882, I have the honor to inclose a copy of dispatch No. 245 from our Minister at Brussels, in regard to telephonic experiments on the ordinary telegraph wires.

I have the honor to be sir,
Your obedient servant,
JOHN DAVIS, Acting Secretary.

Inclosure.—Mr. Fish to Mr. Frelinghuysen, July 20, 1884.

On behalf of the Chief Signal Officer of the army, we have the honor to bring before you a few questions relating to the work which has been done, and the possible future work in atmospheric electricity and ground current throughout this country. I will insert a preface to portions of this by a short historical statement of the manner, in which work has grown on our hands.

You will recall that a few years ago in this country we knew nothing of atmospheric electricity from actual observations that had been published in any scientific journal, except perhaps those of Wisclicrauns at St. Louis and J. D. Everett at Halifax in Nova Scotia. Both these gentlemen had, with good apparatus, made a series of observations on atmospheric electricity. Other than their work, the record of the actual accurate work of this country is almost a blank.

Some years ago the committee of the American Medical Association urged that the Weather Bureau take up this matter, but we replied to them that it was a medical question, that it interested us very much, but that we preferred to wait until the electricians moved in the matter. On the other hand, it became necessary, in 1880–81, to instruct a few observers in atmospheric electricity for observations to be made in the Arctic regions, in connection with the international Arctic expeditions. We also, in 1881, began the instructions of two observers under the special tuition of Professors Trowbridge and Rowland at Harvard and Johns Hopkins, with the view to the training of our observers in accurate systematic observations. Of the actual results thus far obtained by these two men, I need only say that photographic records are now being kept at these two stations. Of the details of the work, Professors Rowland and Trowbridge will be able to state. It was in contemplation to make these the bases of an extended system of 40, 50, 100 or a thousand stations throughout the country reporting to us systematically daily; giving us a daily weather map and electrical conditions of the earth and atmosphere throughout the country, parallel entirely with our daily weather map of isothermals, winds and weather.

We took this up as a study from various points of view. 1st, as terrestrial physics; 2d, on account of its possible general connection with the weather; 3d, partly for the special bearings these disturbances have on thunderstorms, etc.

While we were thus pursuing that course, which, in a few years, would, perhaps, lead to some results, the International Conference held a meeting in Paris this past April, and resolved that they desired to gather up the statistics daily, monthly, annually, as they best could—electrical statistics, as they may be called for by the country, and to make an annual report to the International Conference. That report being transmitted through the Secretary of State and the Secretary of War, comes down to the Chief Signal Officers as an order to carry out this work. So that our small beginning suddenly finds itself forced to expand to a larger undertaking.

We immediately, a few months ago, issued circulars to a number of the electricians of the country, and found that practical electricians, telegraph and telephone companies were in accord with our desire to investigate, observe and map out the daily weather conditions. Some went so far as to say that they had been doing a great deal of work of the kind that had not been published. So far as letters and personal conference with them go, we have every assurance that they have at heart the same interest that we have. There has therefore been addressed to the Commission, and through the Commission to this convention, a general letter stating that the Chief Signal Officer desires to obtain as many reliable observers as possible for that phenomena bearing on atmospheric and terrestrial electricity by daily telegraphic reports, or weekly, monthly or annual reports, as they can best send them in. He is willing to co-operate, as far as may be possible, in gathering these statistics and utilizing them for the public benefit, as well as for the special benefit of the electric companies, if they can make any use of them.

And as indicating a part of the scheme that he had in hand, which is nothing less than the covering of the whole country with electric stations, a memorandum has been submitted of eight or ten questions. Printed copies of these are already in your hands and I will not detain you to read it.

We have in conclusion merely to request that these questions may be referred to proper committees. Other subjects, additional to those, and bearing on the same subject, may be reported on by these committees at some future meeting of the conference or commission, and I hope that we may have your hearty approval and co-operation, and your advice and actual observations as the basis for further research in the matter.

SIGNAL OFFICE, WAR DEPARTMENT,
WASHINGTON CITY, August 18, 1884.

CIRCULAR.

Sent to Electricians and Various Electrical Companies in the United States.

SIR: I have the honor to say that I desire to obtain as many reliable observers as possible of atmospheric electricity, ground currents, telephonic electric disturbances, terrestrial magnetism, and whatever other phenomena are related to terrestrial electricity.

To this end I have requested of the Commissioners who have called the National Electrical Conference, to be held in September, that certain questions be considered and reported on by the proposed Conference, but I take the liberty of thus addressing you in advance, in hopes by previous preparation to facilitate prompt action at the Conference.

The accompanying memorandum will show the scope of the questions which at present suggest themselves.

I am, very respectfully, your obedient servant,
W. B. HAZEN,
Brig. and Bvt. Maj.-Gen'l, Chief Signal Officer, U. S. A.
(One inclosure.)

I move, as a member of the conference, that this communication from the Chief Signal Officer be referred to a proper committee to be reported on within not less than three months.

Mr. Trowbridge: I second the motion.

(The ten questions called for and read.)

MEMORANDUM.

The following subjects are suggested for discussion, with a view to recommending proper observations and reports:

1. What unpublished records exist in the hands of electric lighting, telegraph and telephone companies relative to ground currents and atmospheric or auroral influences?
2. What is the general experience on east-west, north-south, and other lines?
3. What records can be kept by managers of all lines without interfering with daily business.
4. What special observations can be made?
5. What special lines can be, perhaps, wholly devoted to the continuous record of the phenomena?
6. Do or can the noises and currents, as observed on telephone and telegraph lines, give information as to the location and future movement of a thunderstorm, aurora, rain, cold wave, etc.?
7. Are observations on buried lines, or those covered with metallic tubing, or double aerial lines specially desirable?
8. How can we best secure a complete daily electric survey of a given small portion of country, and a general survey of a larger region?
9. What is practicable in the way of securing a daily map of the distribution of atmospheric and terrestrial electric potentials?
10. Who will maintain self-recording electrometers?

Sir William Thomson: With respect to the kind of observation that is most important with respect to the so-called earth currents, I venture to remark that an arrangement for measuring difference in potentials between any two points by means of high-resistance galvanometers taking really the functions of electrometers, is the most important. The object is to measure the potential of the current, and not the strength of the current through the wire. The ordinary telegraph instruments show earth currents, that is, currents through the insulated wires and the instrument of the observer; and the practical suggestion that I have to make is that those stations which can undertake to do work of this kind should be provided with high-resistance galvanometers; galvanometers of 20 or 30 times the resistance of ordinary connecting lines and even more. It may be a thousand or two thousand times. I believe generally the sensibility will be readily obtained by instruments having a resistance many hundred times greater than the resistance of the conducting wire.

Instruments of that kind, made self-recording, might be left in connection during all the time the telegraph line was not in use, and thus, during a considerable number of hours of the day, even busy lines, an indication of the differences of potential between pairs of chosen points in the telegraph system might be obtained. It is the difference of potential of the current through the wire that is the primary object of investigation at this part of the subject.

Prof. F. E. Nipher (Washington University, St. Louis, Mo.), said he would like to have an additional point examined, and that was the effect which a large number of cells grounded at a given point would have upon the potential at that point. If these investigations were to be made at large telegraph stations, that point would necessarily be examined first.

Prof. Abbe: It was by no means possible in this short discussion to cover the whole ground, although many matters might be put in that were thought interesting. I am sure that it is very desirable that all members should speak from their own experience, and suggest their opinions also, all of which should be referred to the same committee.

Motion carried.

The President said that the next subject in order was the adoption of the International Electrical Standards, the discussion to be opened by Prof. John Trowbridge.

Prof. Trowbridge (Harvard College, Mass.): From the delegates to the International Congress of Paris, last April, we have received the following letter through the State Department:

No. 554. LEGATION OF THE UNITED STATES,
PARIS, May 5th, 1884.

The Honorable Frederick T. Frelinghuysen, Secretary of State:

SIR: I have the honor to report that acting under the authority conveyed in your telegraphic instructions of April 8th, confirmed by your despatch, No. 490, I appointed Mr. Vignaud as special delegate of the United States to the International Electrical Conference held in Paris last month, and expressed at the same time the regrets of my Government that the two learned professors who had so ably represented the United States at the first session of the conference, Messrs. Rowland and Trowbridge, were unable to be present at this session. I inclose herewith Mr. Vignaud's report. I have the honor to be, sir, very respectfully, your obedient servant,

(Signed) LEVI P. MORTON.

LEGATION OF THE UNITED STATES,
PARIS, May 5 1884.

Hon. Levi P. Morton, United States Minister, Paris:

SIR: In compliance with the Department's instructions and yours, I attended on behalf of the United States the second session of the International Conference for the determination of Electrical Units.

Being unqualified to take any part in the scientific labors for which the Conference had met, I confined myself to attend its sittings to show that if the United States could not be represented this year by any of its learned scientists, they were not indifferent to the object of the Conference.

The Conference was formally opened on the 28th of April, under the Presidency of Mr. Adolphe Cochery, Minister of Posts and Telegraphs. Twenty-eight States were present, a list of which is herewith inclosed with the names of their delegates.

The comparative calculations which were to determine the electrical units sought for having been compiled in advance, the delegates, who had divided themselves into three committees, soon came to an understanding, and reported to the Conference the following resolutions, which were unanimously agreed to:

1st. *Electrical Units so termed.*

Resolution I.—The legal ohm is the resistance of a column of mercury of one square sectional millimetre, and 106 centimetres in length at a temperature of thaw.

Resolution II.—The conference expresses the desire that the French Government will transmit this resolution to the different States, and recommends its international adoption.

Resolution III.—The Conference recommends the establishment of a primary standard of mercury, conformably with the resolution previously adopted, and, concurrently, the employment of indices of secondary resistance in solid amalgam which should be frequently tested, one with the other, and with the primary standard (ohm).

Resolution IV.—The ampère is a current of the absolute measure of 10-1 in the electro-magnetic unities C. G. S.

Resolution V.—The volt is the electro-motive force sustaining the current of an *ampère* in a conductor of the resistance shown by the legal ohm.

2d. *Electric Currents and Lighting Conductors.*

Resolution I.—It is desirable that the results of observa-

tions gathered by the various administrations should be transmitted every year to the International Bureau of Telegraphic Administrations at Berne, which will draw up reports for communication to the several governments.

Resolution II.—The Conference expresses the desire that observations upon terrestrial currents should be obtained in all countries.

3d. *Standard of Light.*

Resolution.—The unit of each single light is the quantity of light of a similar kind emitted in normal directions by a square centimetre of molten platinum at a solidifying temperature.

The practical unit of white light is the body of light normally emitted from the same source.

The Conference adjourned on the 3d instant.

The papers received from Messrs. Rowland & Trowbridge, the one on the determination of the ohm, the other on atmospheric electricity, were introduced by me at the first sitting and were referred to the proper committee. They will be printed in the Proces Verbal of the Conference, of which a few copies will be furnished in due time.

I annex herewith two sets of scientific papers which were presented to the Conference.

I trust the Department will kindly transmit them to Messrs. Rowland & Trowbridge, for whom, I have no doubt, they will have a special interest. I have the honor to be, sir, very respectfully,

Your obedient servant,
(Signed) HENRY VIGNAUD.

Prof. Trowbridge thought that the ohm, the volt and the ampère were now beyond discussion there. The construction of primary standards should be referred to a committee charged with the establishment of a bureau of physical measurements or electrical units. The point in regard to electrical currents and lightning rods fell properly under the subject introduced by Prof. Abbe. There remained, then, properly for discussion, the standard of light. He presented these resolutions to the chairman, and moved that the adoption of the units be referred to a committee.

The President asked for remarks on the ohm, and said that 106 centimeters did not represent exactly the result of experiments, 106⅓ being nearer; but the round number was thought desirable.

Sir William Thomson (who attended the Paris Conference) said that the general opinion at Paris had been that 106.2 was nearer the truth than 106. though able men who had made careful experiments had gone on the other side of that figure, some as much as one-tenth and two-tenths below, some even three-tenths. The average, however, came within a very small fraction of 106.— less than one-tenth. The thing that seemed to be quite sure was that 106 was nearer the truth than any other integral number, though he believed that most persons present thought 106.2 to be the nearest decimal. It was pointed out that the adoption of 106 would not be practically inconvenient, even though more extended observations may give a number different by one. two, or even three-tenths. A box of resistance coils, or a set of standards, put together in any way, of German silver or of any other metal that might be adopted for standard resistance, would still remain a useful practical instrument for measurement. It would be necessary to alter the designation on the label of the box as to the temperature at which the resistances contained in it are correct. They all understood that for practical purposes, not of the very most minute accuracy, the change of resistance of German silver must be taken into account; still more, of course, that of copper, roughly, ten times as much as German silver at the same differences of temperature. Any difference due to difference of temperature must be taken into account, even if the material be German silver, with which they had a change of resistance amounting to $\frac{6}{10}$ per cent. per ten degrees centigrade, in round numbers. Thus, by changing the designation, the resistance could be corrected within the limits of the atmospheric variation within which the resistance coils have to be used. The coils would remain a practical instrument in the use of which no numerical correction has to be applied, except such as must be applied at any rate, that is, the correction corresponding to the temperature at which the experiment is made.

There was nothing to add, except in justification of the choice of 106. They felt confident that would be accepted as probably the nearest unit on this side of the Atlantic, considering the very important observations which Prof. Rowland had already made, and some of which were among those considered by the Paris Conference, Prof. Rowland's experiments being within two-tenths per cent. of 106, on the side below, and it was regretted at Paris that he had not been able to lay his last results before them. He hoped Prof. Rowland would be able to give them his results, if not inconvenient or prejudicial to final figures.

The President called on Mr. A. L. Kimball to state what had been obtained by the latest experiments.

Mr. Kimball (Assoc. Prof. Physics, Johns Hopkins University): I would state that the first method employed in determining the unit of resistance was the same as that employed by Prof. Rowland in his experiments in 1876—a modification of Kirchoff's method, by which the induction was produced by the reversal of the primary current. We have made a good many experiments with a set of coils constructed on purpose. These were one meter in diameter, and and were at a distance of 25 c.m. apart. There were 75 results obtained from these experiments. The first of these were not so complete as the later ones, so that in averaging we have given three or four early experiments the same value as one of the later set, for reasons which will readily appear in looking over the actual observations.

The result obtained thus far as most satisfactory, considered from internal evidence, is that one B. A. unit is 0.9864 of the absolute unit. That is a result which we feel confident is not in error more than one part in three thousand, and probably less. (Applause.)

Experiments have also been carried on under this same preparation for the determination of the value of the specific resistance of mercury. The result obtained from that is that the column of mercury one meter in length, and one square millimeter in section, has resistance which may be expressed by the decimal 0.9539 in terms of B. A. units. Combining these two results, we find as the specific resistance of mercury in absolute units, a number which indicates that the absolute unit of resistance will be a column of one square millimeter in section and 106.278 cm. in length. This result, as will be seen, agrees very closely with the results obtained by Lord Rayleigh and Mr. Glazebrook in their experiments, and we feel confident that it is correct to within about one part in 3,000.

There are some experiments which have been conducted by the method of Lorenz(?) the reductions of which are not yet quite complete, absolutely. But the reductions have so far progressed that we can say that the extreme of error, of difference between the greatest and least values obtained by that method, is less than one part in one thousand. (Applause)

The President: It would seem from this that our experiments come out at about that figure which we have there (on the blackboard). I do not suppose it will differ very much, and that is very much the mean of the best results so far obtained by foreign experimenters, such as Lord Rayleigh and Mr. Glazebrook. It would seem the quantity is a little greater. Our old experiments, as Sir William Thomson has mentioned, came below this. We have found a cause of error in the sinking of the wire into the layer below, when one binds it, and which I had allowed for, but not enough. Therefore, I think when we correct my old experiments—for that we shall presently do—it will come out about this, but I suppose it is only a small quantity;—one part in 400. I do not think a practical man will object to an error of that amount in the determination, say of the work of a dynamo machine, or any experiment of that nature, as it can be made within one part in 400. I would like very much to hear from some of the practical men here as to whether this quantity will affect their results to any appreciable extent. I think myself it is desirable to have a standard in conformity with the rest of the world. If we wish to be more exact, we can always make these small corrections here indicated.

Sir William Thomson pointed out that the adoption of the legal ohm just now is, after all, only provisional. "But the Conference at Paris," he said, "was very anxious that the provisional character of the legal ohm should not in its results leave any uncertainty whatever that could practically inconvenience or interfere with accuracy in the measurements that are used for fractional purposes, or that could embarrass scientific observers. It was remarked that scientific observers always have a remedy themselves in scientific work, as it is essentially a law to itself in respect to accuracy. But it is exceedingly important to the scientific observer that the ordinary standards he meets with should be in sufficient coincidence with the number convenient for him to use to aid him, without much labor in the way of equalization, in reducing balances and getting the desired results and comparisons." He thought that if the Paris Conference had had Prof. Rowland's results, it would have adopted 106.2, but a few years hence will suffice to reopen the discussion.

Prof. Trowbridge then presented resolutions to the effect that the commission be authorized to take the proper steps toward legalizing the ohm in this country, as adopted by the Paris Conference, also the ampère and the volt. Agreed to. In regard to lightning rods, Prof. Trowbridge presented the following resolution: "It is desirable that the results of observations taken by various offices be sent over to the International Telegraphic Bureau at Berne, which will prepare a statement thereof and communicate to the government." On his motion this was referred, after adoption, to the committee proposed by Prof. Abbe, the work belonging essentially to the Signal Service.

The President: The next question is the Standard of Light. I suppose this will occasion more discussion than anything we have had so far. There is considerable objection in the minds of many to such a standard as platinum which has just been melted and is about to solidify. I would like some motion upon this subject, so that the matter can come before us and be discussed.

Prof. Trowbridge: I should like to move that this resolution on the standard of light be referred to a committee. This resolution reads as follows: "The unit of each single light is the quantity of light of the same kind emitted in a normal direction by 1 sq. c.m. of surface of melted platinum at the temperature of solidification. The practical unit of white light is the body of light normally emitted from the same source." There is a great difference of opinion upon this unit of light, and very many do not see how it can become a practical standard, although a late modification by Mr. Werner Siemens, it seems to me, makes a very reasonable standard of it. Mr. Siemens takes the point of fusion of the platinum strip instead of the point of solidification, passes an electrical current through his strip, and regulates the current until the very moment he wishes to measure the light emitted, and then he measures it through a small conical opening, with certain restrictions. But I do not know of any one besides Siemens who has actually tried the experiment. He obtains in that way, I believe, the light of about $1\frac{5}{10}$ candle-power, and he uses that as a practical standard. However, the question is evidently open for discussion. I have heard many express the opinion that this unit is not the very best that might be adopted, but it seems to be the only one of the resolutions adopted by the Paris Conference which we can practically discuss. Therefore, I move that it be referred to a committee who shall bring the discussion before us, and shall so frame their resolutions that the discussions shall not be desultory, but more or less systematic.

Mr. C. H. Koyle wanted an early date for the committee to report.

Prof. Trowbridge thought that the committee could report in three months, but that the discussion could be opened immediately. He added to his motion that the committee be nominated by the Chairman and be announced at their next meeting; also that it fix a time for the discussion.

N. S. Keith (Secretary of the American Institute of Electrical Engineers): As a member of the Board of Examiners intrusted with the duty of measuring the light given by the various electric lamps in the Exhibition, I am very desirous of hearing at this stage of the proceedings, or as speedily as possible, an expression of opinion, as wide as it may be, not perhaps so much for final action in this matter, as for the guidance of this Board of Examiners. We have already had a little discussion upon this point, and our deliberations, our measurements and our actual performances will certainly be regulated very much by such an expression of opinion. Therefore I do hope, without now being prepared to make an amendment to the motion, that the committee will so report, that we will have a short discussion, to say the least, upon this point, and, of course, at the present sitting of the Conference, before the Conference adjourns.

After discussion as to the best way of procedure it was agreed that the Conference have a discussion on the subject, and that after the discussion, the committee appointed report to the Executive Committee three months from the adjournment, say at Washington.

The President stated that the names of members of the committee would be announced next day.

Mr. W. H. Preece (electrician of the British Telegraph Department): With my brains in a state of ebullition from this unusual and excessive heat, I find it somewhat difficult to bring before you a new point and a new question. I want to propose that there shall be referred to one of the committees already designated, or to a new committee, the question of the consideration of the adoption of a new unit of power. By sheer force of absolute necessity, the rate of doing work by dynamo-machines and of currents generally has hitherto been very largely spoken of as being so many volt-ampères. But two years ago, the late lamented Sir William Siemens proposed a unit of power called a watt, synonymous with the volt-ampère, and one that was so necessary for the purposes of practical electricians that in reality it has been adopted already. But it has not been adopted authoritatively. I was very anxious indeed at the Paris conference to bring this unit before them, and I believe on that occasion I should have been supported by Sir William Thomson. But the German element were opposed to its introduction, first, because we already had so many names, and secondly because there was no "w" in the French language (laughter). Both these reasons were very thin, and we have a very much stronger reason why it should be adopted. That is, the reason of necessity. Therefore I proposed that the subject of the adoption of the watt as the unit of power, or the unit of rate of work, shall be referred to one of these committees.

I want to go still further. The watt is a unit that connects together all practical applications wherever energy is expended in any shape or form; the rate at which it is expended can be expressed by this "watt." Hitherto, for the same purpose, we have used a most unmeaning and absurd unit called a horse-power—that is not a horse-power. Watt himself determined that the amount of work done by a good average horse was something like 22,000 pounds raised one foot high per minute. But he did not like the look of 22,000 foot-pounds; he thought it was too small, so he added 50 per cent. to it, and made it 33,000. Hence a horse-power as at present used means absolutely nothing, and if you have to convert the work done by an electric current, or the work done in an arc lamp or in a dynamo machine, to a horse-power, you have to use a very awkward coefficient—746—that is, there are 746 watts in a horse-power.

Now I have spoken with a great many practical engineers, and some of the most eminent mechanical engineers, and they all assure me that there would be very little practical difficulty in raising the value of the horse-power. If we were to make the present horse-power equivalent to 1,000 watts it would mean that we should raise its present value about 34 per cent., and we should then have a true unit. You may still call it a horse-power. We should have a unit that would be connected directly with the absolute standard of measurement, the C. G. S. system to which so many references are made. It would be exceedingly simple if the new horse-power is adopted to change the old horse-power. All we will have to do is simply to multipiy by 1.34 or to reduce the new horse-power to the old by multiplying by 746—very easy calculations indeed.

Therefore I beg to propose that it be an instruction to the committee to consider the subject: First, the watt be adopted as an authoritative unit of power; and, second, that the value of the horse-power shall be increased to 1,000 watts.—Agreed to.

On motion of Mr. A. Graham Bell it was agreed, for the sake of hearing better, to remove the Conference from the lecture room of the Exhibition to that of the Franklin Institute, placed at their disposal by the president of the Institute, Mr. Tatham.

Adjourned until 2 P. M. Wednesday.

Professor Kinnersley, the Electrician.

The exhibition now being held at West Philadelphia very naturally brings before us, says the Philadelphia *Record*, all those eminent men who were prominent in the celebrated "Philadelphia Experiments," such as Franklin, Kinnersley, Syng and Hopkinson Franklin occupied the first position, as he corresponded with Collinson and others in London, where his letters were published, and he thereby became a great man among the scientists. But in America the man who was better known, according to Dr. Priestley, than Franklin, was Rev. Ebenezer Kinnersley, who from 1753 to 1772 was a professor in the University of Pennsylvania. Of Professor Kinnersley a sketch has been prepared, and is to be seen in No. 7 of the "Bulletin of the International Electrical Exhibition," published by the Franklin Institute. His experiments and discoveries were wonderful, and to him is awarded the honor of delivering in Philadelphia, Boston, Newport and New York the first lectures on electricity ever delivered either in America or in Europe. He died at Lower Dublin, July 4, 1778, and was buried at Pennypack Baptist Graveyard, of which church he was an early member, and there his remains repose, honored to-day by the American flag at his headstone. On it is to be seen an inscription of which the following is a copy:

"This flag is placed here by direction of Horatio Gates Jones, of Philadelphia to commemorate Rev. Ebenezer Kinnersley, A. M., the great American electrician, whose early discoveries and experiments, 130 years ago, in the city of Philadelphia, were instrumental in giving to the world many of the laws which governed the electric fluid.

"It is deemed a proper time to honor Professor Kinnersley, as the National Electrical Exhibition is now being held in West Philadelphia."

While we thus speak of this eminent man let us not forget that at the corner of Fifth and Arch streets lie the remains of his eminent colleague, Dr. Franklin. Why not have an electric light placed at Franklin's grave every night during the Electrical Exhibition at West Philadelphia?

National Conference of Electricians.

THIRD DAY—SEPT. 10.

The Conference was called to order by the President at 3 P. M.

The President: The announcement of committees is now in order. The committee on the subject of electric light measurement, and upon the consideration of Mr. Preece's motion with respect to the Watt, is as follows: Prof. John Trowbridge, chairman; Mr. W. H. Preece, Mr. E. C. Pickering, Prof. C. R. Cross, Prof. G. F. Barker; Mr. T. A. Edison, Major D. P. Heap, U. S. Army. The committee to consider Prof. Abbe's subject is as follows: Prof. Abbe, chairman; Lieut. James Allen, Prof J. Trowbridge, Prof. W. W. Jaques, Mr. F. N. Gisborne, Mr. W. H. Preece, Prof. F. E. Nipher. It is purposed to add one or two more to this committee to represent the telegraph companies of this country. Being unfamiliar with the proper persons, these names have been left to be added. These committees will make a preliminary report, I think, to-morrow morning, so that these subjects can be brought up for discussion by the Conference. I am myself more in favor of having these questions discussed here than I am of having them brought before these committees.

The next business in order is the first subject on the programme, "The Establishment of a National Bureau of Physical Standards," the discussion to be opened by Prof. M. B. Snyder.

ADDRESS OF PROF. M. B. SNYDER.

The establishment of a bureau of standards adequate to the scientific and practical needs of the nation is a topic that may well claim the attention of the public at any time. There are, however, several reasons for raising the question before this National Conference of electricians.

The International Commission having recently determined what the international electrical standards are to be, it remains for this country to give proper and official attention to the important matter of recognizing and establishing such standards.

And again, it is found, at the very outset of a movement in this direction, that the definition and construction of the electrical standards necessarily involves the definition and construction of a number of other physical standards, since to attempt the establishment of a standard of resistance, for example, without reference to standards of temperature, length, or even of mass, would be to fail in the first statement.

But more than all, with the presence, at this conference, of physicists, of practical experts, of manufacturers and others interested, we may expect that this matter will receive the many-sided consideration which its importance deserves.

It may be well at the outset to glance briefly at the present condition of the subject of physical standards in this country. Standards of length and of mass have long since received considerable attention from a department of the United States Coast Survey. This bureau is, I believe, sometimes designated as the Bureau of Weights and Measures, and furnishes standards of this class to the several States.

The original intention of attaching such a bureau to the Coast Survey was undoubtedly to provide proper standards for its important geodetic work, and in pursuance of this intention the bureau has undoubtedly been useful.

We find, however, at a later period, the Department of the Lake Survey independently taking up the subject of the standards of length in a very spirited manner and with a success creditable to those engaged in the work. It is also understood that the Coast Survey itself has recently been active in some improvements in this department.

As for the other standards connected with government operations we have notably the attempts of the Signal Office to determine for their work standards of pressure and of temperature, and we are also informed that in some of the government work preliminary electrical standards have been adopted, though doubt has been expressed as to whether the same standard is used throughout the entire service, and as a matter of course, it is still more doubtful whether these standards harmonize with the present state of electrical science.

It will be noted that all these attempts on the part of government officials to establish physical standards, creditable as they may be in themselves, have been mainly with the view of meeting the necessities of their own particular departments, but are scarcely available for the scientist and the practical public.

Outside of the government departments private enterprise has indeed done much to further the study of this subject, and in several educational centres most laudable efforts have been made to establish and reproduce standards of length and of temperature. Thousands of dollars have been expended by individuals and institutions in this direction, and yet with all deference to, and recognition of, this self-denial and enterprise, it can scarcely be supposed that the private purse will be equal to the support of the amount and the character of work that yet remains to be done in this direction. While, therefore, too much cannot be said in praise of these individual attempts, whether undertaken in the government service or by private effort, to lay a firm foundation for our science and our practice, there still remains the necessity for the establishment of a National Bureau of Physical Standards that shall at once unify all the standards of the various government departments, and also be equal to the real wants of progressive science and actual practice in this country.

It is perhaps important that we indicate in brief and in outline the character of the bureau intended. It should, in the first place, aim to determine and reproduce all the physical standards with relation to each other. In the present state of science it is so manifestly absurd to determine or to even state one standard without respect to the others, that it does not seem necessary to emphasize this point. Still we may, in passing, remind ourselves of the fact that as the matter now stands one must often be in serious doubt as to precisely what subsidiary standards were used in work where observations are not made at a physical zero.

Such bureau would then provide for standards of length, of mass, time, temperature, of electrical resistance, and electromotive force, of light, and also probably provide for other subsidiary standards to the great business interests of the country.

In the second place, the proposed bureau should not only be broad in scope, but should thoroughly provide for two distinct and yet related features. First, the standards should be the embodiment of all the scientific research at present available in these matters.

Some plan should, therefore, if possible, be devised to eliminate the personal equation which even in matters of high scientific research becomes at times unfortunately too prominent. There seems, indeed, no good reason why such a bureau should not avail itself of all the experience and research in these matters that can be supplied by the trained physicists of the country.

Then again methods and means should be provided for furnishing the public with authoritative multiples and sub-multiples of such standards.

This means not only that researches should be undertaken for determining the best methods of copying, multiplying, and sub-dividing standards, but that means should be provided by which the public can readily obtain such copies, multiples and sub-multiples. It should not be difficult for any one, whether engaged in scientific or practical pursuits, to obtain standards of an accuracy equal to the purpose for which they are desired.

It seems moreover necessary to the effectiveness of such a Bureau that it should have the stamp of government sanction and of government support.

Excellent from a scientific standpoint as some of the standards championed by individuals and institutions may be, there is yet wanting the stamp of authority to make these researches definitely valuable to the community.

On the other hand, the standards determined by government departments, have indeed the advantage of quasi governmental authority, but are, as previously stated, in such a shape as not to be either strictly related to each other, or practically accessible to the public.

The character of the bureau here intended should be also defined as incompatible with any present department of the government service. It cannot be supposed that a bureau of physical standards of the character and scope here intended could be either scientifically or practically supported by any one of the present departments of the government service. It should, therefore, in our opinion, both on account of the practical and scientific interests at stake, be both in its constitution and in its business and scientific management a department of its own.

In order to complete a bureau of the character described it would also be necessary to have associated with it a physical laboratory and observatory of no mean pretensions, a laboratory devoted exclusively to researches connected with such work, an observatory that would carefully note the physical conditions under which the standards are preserved, and also, if possible, serve as a central station at which physical observations, to be made by the various departments of the government service and by private individuals, may be compared and to which they may be reduced.

In short, we may say that this Bureau of Standards should occupy with respect to the practical physics of the country precisely the same relation that the Nautical Almanac Office holds with respect to practical astronomy.

And just as formerly government aid was invoked and is now freely furnished for the observation and computation of data which form the basis of the actual work in the astronomical observatory, and of the plain sailing of the mariner—just as government aid has enabled the accumulation of data of every-day importance to the astronomer, the geographer and the sailor, just so should government aid now be invoked to furnish a bureau for the determination, the sub-division, the preservation and the development of a series of physical standards which shall be adequate to the urgent needs of the physicist, and also be available for the practical expert and the manufacturer.

The President called upon Prof. Rogers (Harvard College, Mass.) for remarks. Prof. Rogers then read an admirable paper in which he expressed the opinion that the Bureau of Weights and Measures should be greatly enlarged, or that a new department under government control should be created. He emphasized the importance of having government sanction, stating that the results of investigations and the establishment of new standards were most readily effected by that means. A man's work was often neglected while he labored privately, but as soon as he enjoyed governmental support and approval his work, still done in the same way by the same means, was accepted by his countrymen as authoritative and conclusive. What they wanted in this case was that there should be the official stamp of recognition on new units, and that there should be a bureau in which all questions which relate to standards and units may be patiently and intelligently investigated, and, as far as possible, completely solved and settled.

Prof. J. E. Hilgard (Superintendent of the Coast Survey), said there could be no doubt that the government must have standards, but he thought that the extent to which government should assist in the production of standards, or in furnishing them to the public, was a matter of discussion. His own view was that nothing of this kind can be defined by legislation; that the government can only enact what shall be held in the courts for the proper maintenance of contracts. He would deprecate the establishment of a bureau at which these things were done by the government, by its employés, and he held that a physical constant could not be fixed for 100 years to come. But the government could very well compare and verify for the people standards made by anybody. This was the policy of the British government. Prof. Hilgard pointed out instances in which the English Parliament had established erroneous standards by law, and he added: "You cannot enact physical standards at all, but you can say what may be held in the courts in case of litigation." He believed not in the limitation of all this work of physical research to one government office, but in the prosecution of it all over the country, in colleges, universities, laboratories and workshops.

"But I am still of the opinion that a National Bureau of Standards should be charged with the obtaining and preserving of electrical and other units that they have not now; and I want, since they do not remain constant, that they should be compared from time to time. We may improve the methods of determining them, but let us have no enactment about it." He called attention to the work done by his department as participants in the International Bureau of Standards of Weights and Measures, at Breteuil, which is intended to meet every requirement of physical conditions and determinations. It was established conjointly by twenty States, as being cheaper than twenty bureaus, and he was able to announce that Great Britain had now come into it. He instanced this as showing that the Government was already interested in the matter largely, but he thought there was such a thing as overdoing the matter.

The President: I suppose the object of bringing this subject before the Conference is to obtain some place where electrical standards can be compared. So I suppose the discussion had better refer as much as possible to that, although perhaps the whole thing hangs together. I will now call upon Lieut. Allen, of the Signal Service, for remarks upon the subject.

Lieut. Allen (U. S. Signal Service) here read an elaborate paper showing what had been done in the way of standardizing thermometers.

Prof. Simon Newcomb desired the formation of a Bureau of Physical Standards. He held, with Prof. Rogers, that greater weight is given to work done under official authority, although it be that of the same person whose work previously passed unnoticed. "When one is doing work which he knows is going to be received as definite and final by his countrymen, he takes a great deal more upon himself in consequence of that feeling of responsibility." He believed there was a feeling on the part of the conference in favor of some one common set of standards to be used for electrical purposes, and some places to which to send them for determination. He thought that the work of the Bureau of Weights and Measures might be extended to physical standards, in spite of what Prof. Hilgard had said, and that it might become a branch of the international establishment at Paris, although their electricians could not send their apparatus over, for testing, to Paris. He called attention to the fact that Congress, in its closing hours, had passed a law looking to the general reorganization of the scientific departments of the government, and he held that it would be well to pass a resolution that Congress should take such measures as it might in its wisdom deem proper to bring this matter to a consummation in the United States.

Sir William Thomson then gave an account of the standardizing of thermometers in England at Kew, and he said that they did not want electrical instruments to be inferior in this respect to thermometers. "We have at present volt-meters and ampère meters which are good if they are within two or three per cent of what they profess to be, and which sometimes are not within 10 per cent. There is nothing more difficult than to obtain instruments which have a good condition of constancy in themselves, and when some one has invented or produced or planned an instrument which has in itself the condition of constancy, it is exceedingly difficult to get the value of its coefficient determined. In fact, we have no means of doing it now. That may be seen by the numerous proposals made before the Paris Conference of methods of finding the absolute measure of the strength of any current, as indicated by any given instrument—the electrolytic method, the method by the rotation of the plane of polarization, and several other methods. The subject is in a condition in which any action must be directed by science, and the results of science not yet fully obtained, but results for which scientific men in America, in England, in France, and in Germany, are just now working strenuously." They would be glad to have instruments showing potentials within one per cent. in ordinary use, and which might be trusted for $\frac{1}{2}$ per cent. for more careful measurements. The same thing might be said of ampère meters. Who would not be thankful for an ampère meter showing anything from 1 to 100 ampères within 1 per cent? He believed that before another year such instruments would be available. "Lord Rayleigh has taken this matter in hand especially, and if I had an instrument at the present time that had the elements of constancy in it, and I could get Lord Rayleigh to say that he would undertake with his assistants and co-workers to take that instrument and give me its physical constant, and give me the number of ampères within $\frac{1}{10}$ per cent., which corresponded to the standard position or indication of that instrument, I should be satisfied that I had something which would take some two or three years of my life to find for myself, and something that I might not get with two or three years' work in my own laboratory.

"Now that seems to me to be the position which we must take in this matter. We shall have to have elected or appointed men competent to perform the measurements, or who shall make fundamental measurements which will then make it easy for the rest of the world to make their comparisons." The work of the United States should not be confined to one central bureau, but it ought to look forward to the time as soon as possible, when it would have inspectors of electrical standards in all the various cities and important towns, when house to house lighting, as initiated by Edison, had become general, as it must inevitably. Then they would have English electricians sending their instruments over to this country to be tested. (Laughter and applause.) He closed by giving his cordial support to the motion.

Mr. W. H. Preece: We in England are very much in the same position as you in the United States are upon this particular question. We are also placed very much in the same position as yourselves with respect to our government. We are all sensitive when the government interferes with our affairs in any way, but when we are in trouble or in difficulty we are only too glad and too anxious to call in the aid of the government. Now, in this particular question, our government has done as much as can be expected from it, but it has done what it has under pressure, and under such pressure as you now propose to bring against your own government.

Now, I am quite sure, after what we have heard to-day, that one of the first things we shall do on our return to England will be to try to force our government into doing that which you propose to do, and which is essential certainly in order to prevent what Sir William Thomson has predicted would be carried out—that is, the sending over from England our ampère meters and our volt meters to this country to be tested by your inspectors. We think that that should be reversed, and that you should send your ampère meters and volt meters over to us.

There is an absolute necessity for something of this kind. I have recently been conducting a series of important experiments on this subject with the electric light, and it was essential for me to have instruments which should be accurate, but although I tried and had instruments from every maker known to be fairly accurate, I have scarcely succeeded in obtaining instruments that recorded within an accuracy of about 5 per cent. It was a common thing in an ampère meter to give an error of 10 per cent. With volt meters they were more exact, but at the present moment I do not know of a single instrument in England that can be bought from an instrument maker, that has upon it a certain scale, and that you can rely upon that scale within 1 per cent. I do not be-

lieve that it is within 5 per cent. I am sure it is not within 1 per cent.

Now, we must have in England, and you must have here in America, an office under the control of the government, where such standards can be kept, where you can send your instruments to be verified, as we send our thermometers to Kew, or the nautical man sends his chronometer to Greenwich. So a man should be able to have his volt meters, and ampère meters, and all other physical instruments, measured, and measured as they ought to be, with the authoritative stamp of the government upon them. I sincerely hope that the proposal before this meeting will be carried and that we will agree upon a resolution recommending the establishment of such an office here, and I hope we shall establish on the other side a similar office.

Prof. E. J. Houston (Central High School, Philadelphia): The age in which we live is one of practical applications of electricity— lectric light, electric telegraphs, and telephonic communication, and I think there is one idea that has not yet been thoroughly dwelt upon, which would show the very great necessity for the establishment of a National Bureau of Standards. That is, that if the information were placed before the public in an authoritative way as to what shall be the value of these standards, it would go a great way towards making the public conversant with them. The result will be to familiarize the public with the meaning of words that are now coming into very common use, and which I think will in a few years be as common as "pounds" and "inches" now are among the people. I think it is a matter of very great importance for the public to be taught the use of physical terms, and the terms employed in electricity; and that they be taught to use them accurately.

Prof. Snyder: I move that a committee of seven be appointed to consider the feasibility of establishing a National Bureau of Standards, to report their recommendations to the Electrical Commission by the first of December next.

After a little desultory discussion, the motion was withdrawn temporarily, and a motion made by Prof. Abbe insisting on the importance of the desired bureau

N. S Keith: To-day there are inspectors in the various cities of the United States, of gas meters. They stand between the gas producer and the gas user. They have their legal mode of proceeding, and their instruments are in a measure legalized by the inspection to which they are submitted. The time is coming, as Sir Wm. Thomson has so happily and forcibly suggested, when house to house lighting, house to house utilization of electrical energy, will be extensive. Meters have been devised for measuring this electric current so utilized, and it seems to me very proper that this Conference should seriously impress upon our government the necessity of the establishment of a Bureau of Standards, which shall hereafter be employed by the various States and cities in making determinations of meters—standards which we shall be obliged to use. If these standards did not exist, and if these inspectors and instruments were not created, there would be daily trouble between the producers and consumers of gas, and innumerable lawsuits or disputes. We know that there are disputes in abundance now as between the two parties, but the matter becomes simplified when it reaches the courts, because there has been a legalization of standards to certain degrees—standards of light, standards of measurement of the material that gives light. The same are wanted for electricity. (Applause.)

Prof. Wead (of Ann Arbor, Mich.), wanted a little more definite information as to the nature of the bureau to be asked for.

Prof. Sylvanus P. Thompson (Bristol, England), said that if he might be allowed to give a little fatherly advice to the Conference, it would be not to unnecessarily complicate the question of a bureau for verification with that much more debatable matter, the establishment of a bureau for research.

Prof. Abbe approved Prof. Thompson's suggestion heartily. He suggested that the resolution on the importance of a bureau should read, "a bureau for the verification of physical standards, national and international."

Prof. Rogers objected to the word "International."

After discussion on a motion to table and on various amendments the original motion was carried.

The president appointed a committee on the subject of Profs. Rogers, Newcomb, Wead, and it was resolved that his name be added.

The Conference adjourned until Thursday, 11th, at 10 A. M.

Our extended report closes this week with the proceedings of the 10th; the other three days will be given in full later, as soon as the verbatim notes of our reporters are written out. At the meeting on the 11th, a committee report was made in favor of legalizing the Watt, and another report recommended a standard of light for temporary purposes. Prof. Rowland made an address on the theory of the dynamo-electric machine, and the discussion that followed was participated in by Prof. Thomson, of Lynn, Mass., Prof. Sylvanus P. Thompson, Prof. T. J. Fitzgerald and N. S. Keith. The committee appointed to prepare resolutions on the subject reported a series of resolutions in favor of a Bureau of Standards, and the proposal met with approval from a large majority of the members. On the 12th Prof. F. E. Nipher opened the discussion on the electrical transmission of energy, and was followed by Prof. E. J. Houston and Prof. Sprague. A most interesting debate was opened in an admirable manner, on secondary batteries, by Mr. W. H. Preece, who is a firm advocate of them. He had the support of N. S. Keith and Prof. Carhart, and the important points raised were also handled in a vigorous way by Messrs. C. H. Koyle, F. J. Sprague, G. Forbes, F. C. Van Dyck, Elihu Thomson, Lieut. Jewell and Prof. Dewar. After a recess, the Conference reassembled at 3 o'clock. The Committee on Atmospheric Electricity made a preliminary report as follows:

The committee recommend to the National Conference and to the United States Electrical Commission that the Government be urged to take steps to secure on a large scale observations of atmospheric electricity and the strength of earth currents.

That the methods of observation and reports conform as far as possible with those about to be disseminated by the International Bureau of Telegraphic Administration at Berne.

That the Government appoint a permanent committee of five electricians to cooperate with the Chief Signal Officer of the Army in organizing this service.

That this committee shall include, among others, the electricians of prominent companies, such as the Western Union Telegraph and the Bell Telephone companies, and others of wide experience.

The subject of secondary batteries again cropped up, but the main topic of the afternoon was induction in telephone lines, long-distance telephony, and underground wires. Mr. Thomas D. Lockwood read a characteristic and very able paper on these subjects, reiterated opinions connected with his name, adduced new reasons in support of them, and made a strong case for improvement in the transmitter. The paper was heard with great interest, and was reviewed in a masterly style by Mr. W. H. Preece, who adduced some facts from English experience. The general feeling of the Conference was that as regards long-distance telephony, the present limits of practicability on land lines will soon be greatly exceeded, but that the future is somewhat doubtful for submarine and subterranean telephony.

The Conference met for the last session on the 13th. Capt. O. E. Michaelis read a paper on the "Electrical Investigation of the Physical Qualities of Structural Metals." Then followed a talk upon the unfinished programme—the measurement of large currents and the application of electricity to military and mining engineering. Protection from lightning was subsequently brought under consideration, the general deduction from which was that lightning rods were essential to the safety of houses in latitudes liable to storm. Prof. Houston occupied the chair throughout all the discussions that day. The Conference adjourned subject to the call of the President of the Commission.

The National Telephone Convention.

The sixth annual meeting of the National Telephone Exchange Association was opened in the Continental Hotel, at Philadelphia, on the 16th inst. Nearly one hundred active and honorary members, representing thirty-four distinct telephone companies, were present. The cities represented included every notable business centre from Maine to California.

In the absence of the President, Vice-President Eckert, of New York City, called the Association to order.

There were present the following active members of the Association: Messrs. S. H. Cowles, H. C. Palmer, E. J. Hall, Jr., H. S. Thornberry, R. S. Boyd, T. B. Doolittle, T. D. Lockwood, G. F. Durant, Henry Bentley, Dr. S. M. Plush, T. E. Cornish, Henry Metzger, R. M. Bailey, H. R. Rhoads, C. A. Nicholson, G. B. Shephard, H. L. Storke, A. B. Uline, W. H. Cull, E. S. Babcock, Jr., E. T. Baker, F. C. Timpson, W. H. Eckert, G. L. Phillips, W. A. Jackson, F. Drake, W. D. Sargent, J. C. Reilly, C. H. Barney, W. N. Estabrook, J. D. Speed, James Clark, H. N. Gifford, J. N. Sabin, J. W. Duxbury, J. O. Wilson, William Ker, C. E. McClues, J. D. Easterlin, W. J. Cole, Samuel Ivers, M. F. Tyler, H. P. Frost, E. B. Baker, George N. Stone, E. B Field, H. C. Haskins, C. N. Fay, G. L. Phillips, S. M. Bryan, James Merribew, W. T. Westbrook, D. I. Carson and James Bigler. The Honorary Members present were: C. F. Sise, F. A. Mason, G. L. Beetle, E. V. Cherry, W. A. Childs, A. G. Day, F. B. Knight, G. C. Maynard, E. F. Phillips and W. H. Sawyer. Mr. John Cassidy, of the Sandwich Islands, Superintendent of the Hawaiian Telephone Company, and Mons. A. Berthon, *Ingenieur Chef des Services Techniques de la Société Générale des Telephones*, Paris, were also present, and were elected honorary members.

The following officers were then elected: President, Morris F. Tyler, Southern New England Telephone Company, New Haven, Connecticut; Vice-President, William H. Eckert, Metropolitan Company, New York; Secretary, W. D. Sargent, New York & New Jersey Company, Brooklyn; Treasurer, H. L. Storke, New York.

At the afternoon session the report of the committee on legislation was read by the chairman, William H. Eckert, of New York. The report dealt in the main with the restrictive legislation passed in the several States against the telephone "monopolies." A bill, recently introduced in the Ohio Legislature, compelling companies to place their wires underground, had not yet become a law, and in Delaware the Legislature had failed to pass a bill levying a tax of ten cents on every pole within the limits of the State, but in other States the telephone people had been far less successful in warding off restrictive legislation. The New York Legislature passed a bill, taking effect January 1, 1884, putting a tax of 2 per cent. on the gross receipts of telephone companies, while in Tennessee a recent bill levies a tax of fifty cents on each connection. Other States have passed similar legislation. In St. Louis the use of the streets is prohibited, even after the passage of ordinances granting such privileges, except upon the agreement of the companies to file with the Controller on January 1 of each year a statement of their receipts, expenditures, profits and general condition, and the payment into the City Treasury of 2½ per cent. of the gross receipts until 1890. After 1890 a tax of 5 per cent. will be exacted. In New Orleans $5 a pole is charged, and the city demands ten free telephones for its exclusive use. In Pennsylvania the Legislature imposed a tax of $1 per pole, but no efforts have been made to enforce the law, and it may be contested.

After the report had been read F. Drake, of Omaha, took the floor and protested against the publication of the facts contained in the paper. "These are matters," he said, "which the public have no right to know, and I contend that to give them publicity is to stand in our own light. To publish the facts concerning these restrictive laws is to set down a precedent for cities where prohibitory action has not been taken. Incited by the meddling of legislators in other cities, there would be no end of legislation tending to injure our business. I am opposed to this matter becoming public."

C. N. Fay, of Chicago, defended the publication of all or part of the report as leading to a better understanding between the public and the companies. H. L. Storke, of New York, said he had never heard of a company being crippled by restrictive legislation and the public were entitled to know the laws of the several States governing the companies.

John J. Sabin, of San Francisco, vigorously opposed giving the public information, but President Tyler said, and the meeting sustained his decision: "We are enjoying public franchises and privileges and we have no right to hide from the public anything that it is entitled to know. The greatest publicity will work us the greatest good."

A. Berthon explained the operation of the Parisian company of which he is superintendent. In France, he said, the telephone had reached a high state of perfection, having secured a perfect induction of the wires. All the wires were run through the sewers. The principal apparatus used in Paris is that of the Edison system. Within five years, it is expected, the government will purchase the plant of the telephone company and run it for its own profit. At least, it reserves the right to do so.

The report of W. D. Sargent, chairman of the committee on central office and exchange systems, gave interesting statistics concerning the development of the telephone business throughout the United States. In Baltimore the number of telephone connections have reached 1,450; New York, 4,210; Brooklyn, 1,846; Cincinnati, 2,238; Detroit, 1,700, and Albany, 1,102. The statistics of Philadelphia were not given.

On the second day M. Berthon exhibited diagrams showing the duplex and multiplex telephone systems as used in France, and explained how the French metallic circuit doubles the capacity of a single circuit and avoids induction. The subterranean circuits in Paris, he said, are so successful because they are not "buried" in the American sense of the term. They are strung overhead in the sewers—chambers sometimes as large as to admit of four carriages to be driven abreast. His remarks were listened to attentively, and were warmly received.

The presiding officer read an invitation from Dr. S. M. Plush, general manager of the Bell Telephone Company in Philadelphia, to the delegates to visit the Exchange in that city, and it was unanimously accepted.

The Clark Insulated Wire Company was then admitted to honorary membership, after which the delegates regaled each other with stories of their telephonic experience.

At 4 P. M. on Wednesday the convention adjourned *sine die*.

The next meeting will be held at Providence, R. I., on the second Tuesday in November, 1885.

Exhibition Notes.

IF we remember right, the Paris Electrical Exhibition—the first of the kind—had a fire by way of a starter. Philadelphia seems determined to keep pace with the Frenchmen, and, in addition to a first-class electrical show, had a startling alarm of fire Wednesday night, the 10th. A railroad car containing a lot of waste paper, rubbish and refuse, standing on the tracks inside the Electrical Exhibition grounds, caught fire and was destroyed. The fire occurred after the place had been closed, and but few persons were within the inclosure.

Some excitement was caused in the neighborhood, and for safety's sake an alarm was struck, but this proved scarcely necessary, as the flames were quickly extinguished without serious damage, or any danger to the Exhibition.

THE great naval torpedo search light is not situated at a very great altitude on the Electrical Exhibition at Philadelphia, yet it is seen with sufficient clearness to excite attention and wonder in towns 30 miles distant. The morning after the first night that this powerful light was shown, the *Every Evening* (newspaper) of Wilmington, 28 miles distant, telegraphed to the Associated Press to inquire if the Exhibition was sending up electric lights in balloons.

The attendance at the Exhibition has been very good in spite of the hot weather. About 75,000 people will have visited the show between the opening day and the present time, in spite of the unusually hot weather.

The 15,000 school children of Philadelphia who are to visit the Exhibition have already begun to throng the aisles

and bewilder the exhibitors with extraordinary questions. The children come in batches from the various schools, in charge of their teachers, and are very generally accompanied by their friends. It is said that the 72 prizes of $5 each will be earnestly and largely competed for. The points to be considered in deciding upon the merits of the essays are the discrimination exhibited in selecting the object which forms the subject matter of the essay, and the clearness, neatness and accuracy with which this object, the scientific principles which it involves, or the uses to which it is applied, have been described. The essay need not necessarily be confined to one object. Rhetorical qualities are not to be considered, and unimportant grammatical errors are to be disregarded. The essay is intended to be a test of the pupil's observing powers and his ability to describe accurately in simple terms what he has actually seen and examined for himself. The committee to make the final decision upon the merits of the essays will consist of the Superintendent of Schools and two members of the Franklin Institute, to be selected by the President of the same.

The great feature of the Exhibition show on the night of the 15th was the lighting up for the first time of the big Edison cone of 1,000 incandescent lamps, in the presence of the inventor himself. The effect was most brilliant, the flood of light being almost blinding and far exceeding anything as yet witnessed at the show. Mr. Edison made a tour of the exhibits after his great tower of lights had been set ablaze. The show was at its best, and the great throng of visitors present had a grand night of it.

The memorial library is already taking good shape under the hands of the indefatigable librarian, Mr. Hildebrandt. It is in the annex, and will probably reach about 2,000 entries The exhibit of the Patent Office, in the annex, is also extremely interesting, as the models give an excellent idea of the crude shape in which some of the greatest inventions first became known.

Our esteemed French contemporary, *La Lumière Electrique*, is represented at the Exhibition by the following members of its staff: Messrs. Abdank Abakanowicz, Bertrand, G. Duché, Auguste Guerout, O. Kern, and D. Napoli. We have had much pleasure in meeting, in addition to these gentlemen, Mr. H. Alabaster, of the *Electrical Review*, London, who is determined that his paper shall be thoroughly informed of all that is going on.

THE TELEGRAPH.

THEN AND NOW.—Forty years ago there was not a telegraph office in existence, and to-day the number reaches 51,840.

THE MACKAY-BENNETT CABLES.—The first Mackay Bennett cable has already been used, and considerable progress is reported with the second. A special dispatch of the 15th inst. from London to the New York *Herald* says: "A large number of the members and associates of the Society of Engineers have been visiting the telegraph and cable works of Messrs. Siemens and witnessed the coiling of the last portion of the Mackay-Bennett cable in the Faraday. They examined how the cable was tested in the ingeniously contrived pressure tank, representing the average pressure of the ocean, and they pronounced the new cable the most interesting, accurate and wonderful yet fashioned."

THE TELEPHONE.

INSTRUMENTS FOR CHILI.—The Chilian Telephone Company, organized by Boston parties, has taken 500 sets of instruments since July 1.

IN CHANCERY.—The case of the rival telephone companies came up again before the Vice-Chancellor at Newark, N. J., on the 15th. Some discussion resulted in a further postponement for two weeks, when the case will come on for argument. Meanwhile answers and rebuttal will be filed, and the injunction secured by the Domestic Company, of Newark, against the New York companies, will continue.

THE ELECTRIC LIGHT.

ST. JOHN, N. B.—The *Globe*, St. John, N. B, of Sept 4, reports: Mr. Patrick gave an exhibition of the Brush-Swan electric light system in the Dufferin Hotel last evening. There were many callers at the hotel, and all pronounced the exhibition a great success. The incandescent lamps were attached to the gas chandeliers, and they gave a fine, strong light, without flickering. There were seventeen lights in all, and they were turned on and off at will. The electricity is generated at Mr. G. F. Thompson's, and thence conveyed by a wire to the storage battery in the house using the light. A meter is provided to show the quantity used. The New Brunswick Electric Light and Power Company, of which Mr. Patrick was the promoter, is now prepared to supply houses in St. John.

MISCELLANEOUS NOTES.

PRODUCING MAGNESIUM BY ELECTROLYSIS.—A large lump of magnesium has been shown by Dr. Frolich to the Berlin Physical Society as the product of an electrolytic industry, the process of which is based essentially on the melting of chloride of magnesium and decomposing it in the melted state by an electric current.

STOCK QUOTATIONS.

Telegraph, telephone and electric light quotations on the New York Stock Exchange, the Boston Exchange and elsewhere are as follows:

TELEGRAPH.—Am. Cable, b 53⅛, a 55; B. & M., b 3⅛, a 10; Mutual Union, b 12, a 14½; Postal Stock, a 4; Postal sixes, b 26, a 31; Western Union, b 64⅛, a 64¼.

Mr. Bates, of the Baltimore & Ohio, says that company will extend its line to all important points. It starts out in Boston with four wires to New York, and will double the number as soon as possible.

Leading firms say that Western Union's reported surplus of $4,403,658 is not in cash, but the most part is money expended for construction, the details of which and the amount are known only to the insiders.

The managers of the Bankers & Merchants' Telegraph Company have practically decided to allow the concern to go into the hands of a receiver. This has been decided upon so that all interests may be protected and so as to facilitate a speedy reorganization.

TELEPHONE.—American Bell, b 161, a 162; Erie, b 16; Mexican, a 1¾; New England, b 25, a 26; Tropical, a 1½.

The Boston *Herald* of Sept. 16 says:

Bell telephone moved up to 162, New England to 26, while Erie fell back to 16. The market is, for the time, strictly obedient to the law of supply and demand.

Mexican telephone is lifeless at 1½ bid, 2 asked. A dividend is promised between January and April, 1885. The company appears to be doing well.

ELECTRIC LIGHT.—American, b 9; Edison, a 100.

The Electric, Manufacturing and Miscellaneous Stock Exchange of New York is to be reorganized. In addition to its present field of operations, it is to deal in petroleum. The present membership will be increased from 250 to 1,000 members, and the secretary has been authorized to sell memberships. The first allotment of 100 are offered at $25, the second at $50.

BUSINESS NOTICES.

KEUFFEL & ESSER.—Attention is specially called to the card of Messrs. Keuffel & Esser, 127 Fulton street, New York city. The imported Swiss drawing instruments of the firm are of the finest quality, and have all the latest improvements. Our readers will do well in buying direct from the firm, as many imitations of these goods are offered and sold in this country by unscrupulous parties. Another thing, made by Keuffel & Esser, deserving the notice of electricians, is Helios, or blue process paper, for taking copies of drawings. The firm have their own factory at Hoboken. We have ourselves tried many of their drawing materials, and can speak highly of all from experience, quality being excellent and prices extremely reasonable. We advise our numerous readers who do their own drawing to send for catalogue and price list.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

Edited by N. S. KEITH, Electrical Engineer and Expert, 9 Murray Street, New York.

PATENTS DATED SEPT. 2, 1884.

Apparatus for Automatically Opening Closed Circuits; J. P. Tirrell, Boston, Mass. 304,376

Consists in the combination of an electric circuit having one or more branch circuits, each provided with an electro-magnet and with suitable gas-lighting devices, a spark-coil or its equivalent in said circuit provided with one or more armature switching devices, adapted to cut out a branch circuit when said armatures are fully attracted, and a mechanical resistance or retarding device, whereby the armature or armatures of the spark-coil are prevented from being fully attracted by a momentary closure of the circuit.

Connection for Electric Circuit; J. Baker, of Brooklyn, N. Y. 304,593

Device by which electrical conductors may be crossed without danger of improper electrical connections.

District Telegraph Call Box; W. Fix and C. Herrmann, New York City. 304,518

The invention consists of a circuit-breaking wheel that is applied to a vertical shaft turning in bracket-bearings of the inclosing-casing, said shaft having at one end a spiral groove flaring at one side, into which projects a pin at the inner end of a spring-actuated slide-rod having an exterior knob. An escapement-wheel on the shaft of the circuit-breaking wheel is engaged by pallets of a vertical spindle, having weighted wings that retard the motion of the circuit-breaking wheel. A stop-pin on the shaft of the circuit-breaking wheel forms contact with the slide-rod when the rotation of the circuit-breaking wheel has been completed.

Dynamo-Electric Machine; C. J. Van Depoele, Chicago, Ill. 304,378

Consists in simplification of the construction of field magnets.

Dynamo-Electric Machine; A. G. Waterhouse, New York City. 304,382

Consists in the combination, upon one and the same ring armature, of coils wound after the "drum fashion," that is, over the exterior of a cylinder longitudinally and across the ends—and coils wound after the "ring fashion"—that is, wound in and out around the circumferential axis of the ring.

Dynamo-Electric Machine; A. G. Waterhouse, New York City. 304,383

The bobbins of a ring armature are connected so as to be short-circuited at the moment when passing the break between them; but the directions of the currents at the moment are in opposition.

Dynamo-Electric Machine; A. G. Waterhouse, New York City. 304,384

Consists in the manner of connecting the armature-conductors and in commutating the currents.

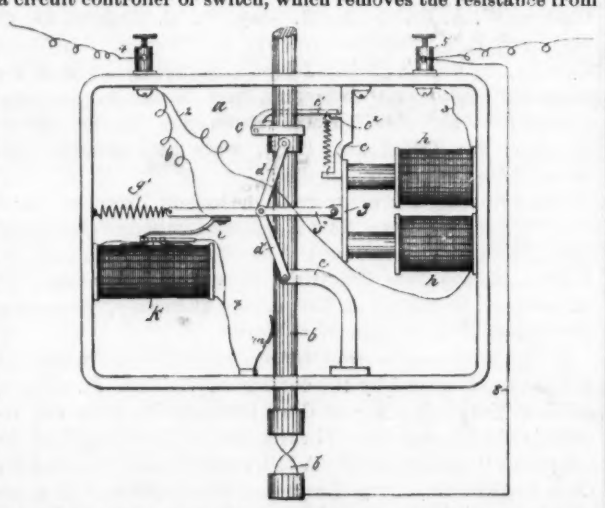
Electric-Arc Lamp; T. G. Turner, New York City. 304,473

Consists in details and combinations thereof in a lamp, the feed movements of which are controlled by a brake.

Electric-Arc Lamp; J. J. Skinner, Newton, Mass. 304,678

Consists in the combination, with the controlling magnet placed in a shunt-circuit, of appliances whereby the said magnet is energized when the carbons are in contact, and while the arc resistance is small, the said magnet operating by its continued attraction to first separate the carbons and establish the arc, and subsequently to produce the feed of the carbon, when the strength of the said magnet is still further increased by the lengthening of the arc due to the consumption of the carbons.

The lamp is provided with resistance, which, before the current begins to flow, is included in the main circuit through the carbons, and thus causes a sufficient portion of the current to pass through the shunt-magnet to energize the latter, the armature of which is connected with the usual clamp or carbon-controlling device in such a manner that the said armature in its movement caused by the attraction of its magnet will lift the upper carbon, thus establishing the arc, which, by its resistance, tends to still further strengthen the said magnet. The armature also operates a circuit controller or switch, which removes the resistance from



the main circuit, preferably gradually in proportion as the arc is lengthened, so that the resistance of the arc takes the place of that removed from the circuit.

Electric-Arc Lamp; J. J. Skinner, of Newton, Mass. 304,679

The formation of the arc and the subsequent feed-movement is effected by the shunt magnet of high resistance. Devices for necessary short and open circuiting are provided

Electric-Circuit Closer; G. Pirnie, Nyack, N. Y.. 304,557

A catch is provided to engage the circuit-closing lever and hold it in position until released by moving the catch.

Electrical Conductor; E. D. McCracken, Paterson, N. J. 304,539

Paper strips are wound around the wire and stuck together by solution of caoutchouc.

Electric-Focusing Lamp; C. J. Van Depoele, Chicago, Ill. 304,377

A lamp actuated by a rotatory electric motor, the armature being in the branch of the main circuit.

Electric Light Regulator; W. Robinson, of Boston, Mass. 304,455

Embodies devices for feeding forward the moving electrode, permitting the feed mechanism to be raised without increasing the length of the arc, and for cutting the lamps out of circuit when out of order.

Electro-Mechanical Signaling Apparatus and System Therefor; M. Toulmin, Washington, D. C. 304,583

The invention has for its objects, first, to provide an apparatus for automatically indicating to a locomotive-engineer or other person having charge of a railway train whether the track between two given points is occupied or unoccupied by any other train; second, to provide such an apparatus with a duplex circuit-closer, which, by the passing of a train, will simultaneously close the main line circuit of the railway section the train has just passed over, whereby the apparatus last passed is stopped, and the local circuit of the next preceding railway section, whereby the apparatus of that section is started; third, to provide such an apparatus with a local-circuit electro-magnet and a main-line circuit electro-magnet, the one to start the apparatus by the closing of its circuit and adapted to be held in such closed position by mechanical devices after said circuit is broken, and the other to free such mechanical devices to stop the apparatus by the closing of its circuit; fourth, to provide such an apparatus with a dial having a transparent line or portion and with an indicating-hand having a like portion, the transparent portions being constructed to present different colored lights.

Fire-Alarm Telegraph System; O. H. Norton, Peoria, Ill. 304,351

My invention consists of any number of telephones, each having an appropriate number inscribed thereon, circuit-wires communicating from them to the central fire-alarm station, and an instrument at said station whereby any one of said telephone numbers can be struck simultaneously upon the different fire-alarm bells.

Means of Controlling Induced Currents in Electric Conductors; E. D. McCracken, of Paterson, N. J. 304,540

A compound electric conductor consisting of a primary conductor, an insulation therefor, composed of a spirally-wound and lapping strip or strips of pure vegetable paper, a spirally-wound induction or secondary conductor external to the said insulation, and a spirally-wound strip or strips of pure vegetable paper applied outside said induction or secondary conductor, the paper forming of itself insulating-coverings for the primary and secondary conductors.

Operator's Receiving Telephone; W. L. Richards, Malden, Mass. 304,667

Arranged with springs for easy retaining upon the head of the operator.

Printing Telegraph; H. Van Hoevenbergh, of Elizabeth, N. J. 304,475

The printing of the double-line is done on a single platen common to both type wheels in a stock quotation instrument.

Sound-Reflector for Telephones; F. D. Torre, Baltimore, Md. 304,413

Consists in a sound receiving and condensing instrument, which may be adapted to be used in connection with any sound receiving and transmitting device, as a telephone of either the electrical or mechanical class.

Thermo-Electric Regulator for Heating Purposes; J. A. Lakin, Westfield, Mass. 304,330

Relates to thermo-electric apparatus for operating damper of furnaces.